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MONTANA HIGHWAY FUNCTIONAL CLASSIFICATION AND NEEDS STUDY (1970–1990)

An Engineering Study Report

For the:

Montana State Highway Commission
Planning Survey Section

In cooperation with the
Department of Transportation
Federal Highway Administration

By:

Menasco–McGuinn Associates
Helena, Montana

March, 1971

The opinions, findings, and conclusions expressed in this publication are those of the authors, and not necessarily those of the Federal Highway Administration.

Menasco–McGuinn Associates
Designers - Engineers
2717 Airport Way
Helena, Montana 59601

March 25, 1971

Mr. Paul R. DeVine, Director
Planning Survey Section
Montana Highway Commission
Hustad Center
Helena, Montana 59601

Dear Sir:

In accordance with our contract agreement, we are pleased to submit this engineering report on the Montana Highway Functional Classification and Needs Study (1970–1990).

This Study has been concluded in compliance with the 'National Highway Functional Classification and Needs Study Manual (1970–1990)' issued specifically for this Study by the Federal Highway Administration–United States Department of Transportation.

The coordination and involvement required by this Study, as well as the information and analyses contained herein, should contribute materially to the transportation planning process in Montana, and will provide a cornerstone for further coordinated transportation planning in the State.

We wish to extend our sincere appreciation for the outstanding cooperation that we have received from the Planning Survey Section–Montana State Highway Commission and the Federal Highway Administration. This spirit of cooperation has enabled us to complete the Study on schedule in the limited time span allowed.

Sincerely,

Ralph L. Menasco, President

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PART I

PART I — INTRODUCTION

I. National Transportation Planning Study
   - A. Purpose and Scope
   - B. Organization
   - C. Requirements of Study

II. Montana Highway Functional Classification and Needs Study
   - A. General
   - B. Scope and Objectives
   - C. Study Organization
   - D. Responsibilities of Each Agency

I. NATIONAL TRANSPORTATION PLANNING STUDY

A. Purpose and Scope

The United States Department of Transportation has the statutory responsibility to provide recommendations on transportation policy to the United States Congress and to administer a number of federal transportation programs. To meet these responsibilities, the Department of Transportation has initiated a National Transportation Planning Study that will study all domestic modes of transportation in every state and metropolitan area in the United States, the District of Columbia, and Puerto Rico. Both public and privately owned transportation facilities will be investigated in this Study, which will be the first of a continuing program to assess the Nation's transportation system, with biennial reports to Congress.

Involved in the development of information will be many federal government agencies, transportation equipment manufacturing firms, firms concerned with interstate transportation, common carriers, and state and local governments. The Department of Transportation will coordinate the collection and analysis of information at the national level and will determine a set of transportation development alternatives to be submitted to Congress.

The state and local governments will provide a major part of the input into the National Transportation Planning Study, and their maximum involvement has been solicited so that individual state and local needs will be reflected. To insure consistency of input so that valid comparisons between states can be made, a series of manuals has been written by the Department of Transportation to instruct the state and local governments in their collection and analysis of data. These manuals of instruction are:

Manual 'A' – *General Instructions*

Manual 'B' – *Highway Functional Classification and Needs Study*

Manual 'C' – *Urban Public Transportation*

Manual 'D' – *Airports and Other Intercity Terminals*

The instructions contained in these manuals are relatively explicit so that reasonable consistency on a nation-wide scale can be achieved. In addition to their statutory requirements, the manuals are intended to encourage continuing comprehensive planning of publicly used transportation facilities and service, and to aid in evaluating recommended methods of allocation of federal resources.

B. Organization

The governors of each state have been requested to assume the responsibility for the development of transportation plans and program estimates within their jurisdictional limits. The recom-

mended procedure is for the governors to designate planning agencies to provide the coordination required in determining a transportation plan for each state. Involvement of and input from existing state and metropolitan planning groups has been requested so that existing local policies and plans can be incorporated into the Study.

It is intended that the governors' representative assign the required tasks to local and state participants, and work with the Department of Transportation to insure that the Study requirements are met. He also coordinates his state's transportation plan with contiguous states, and assembles the summary information in a report to be submitted to the Department of Transportation.

Maximum use of available studies and information has been recommended inasmuch as considerable work on diverse segments of transportation facilities has already been done in previous state-federal joint efforts.

The organization that has been designated by the Governor of Montana to coordinate Montana's portion of the National Transportation Planning Study is the Montana State Department of Planning and Economic Development.

C. Requirements of Study

Specific information has been requested from the states by the Department of Transportation for input into the National Transportation Planning Study. In preparation for a state transportation plan, the states have established transportation goals and objectives that are consistent and compatible with the particular needs of each state.

As a part of the state transportation plan, the future population distribution and growth, as well as economic activity within a state, have been determined. Boundaries which delineate the division between urban and rural areas have been estimated because of the difference in transportation requirements between urban and rural areas.

A realistic estimate of the needs for each mode of transportation, disregarding existing budgetary restrictions, is another requirement. These estimates are based on reasonable standards of transportation service, and should be in accordance with the designated goals and objectives. The estimates should also be consistent with anticipated population distribution and growth. Costs of the needs are estimated and included.

The final requirement is the determination of specific capital improvement programs for various transportation alternatives. These alternatives include an evaluation of various levels of funding as well as modifications to existing restrictions on federal aid participation. Summaries of the capital improvement programs are to be forwarded to the Department of Transportation for analysis, and will be presented to Congress, with recommendations, as a set of transportation development alternatives.

II. MONTANA HIGHWAY FUNCTIONAL CLASSIFICATION AND NEEDS STUDY

A. General

The Montana Highway Functional Classification and Needs Study is the highways portion of the National Transportation Planning Study for the State of Montana. The instructions for the Highway Study are contained in the National Highway Functional Classification and Needs Study Manual, which is Manual 'B' of the National Transportation Planning Study.

The impetus for the Highway Study is found in Senate Joint Resolution 81, approved in August, 1965, which calls for a continuous series of biennial reports on the future highway needs of the Nation to be prepared by the Department of Transportation. Figure No. 1 shows the organization and flow of authority for the Highway Study.

B. Scope and Objectives

The Montana Functional Classification and Needs Study encompasses all existing mileage and proposed mileage to the year 1990. This Study classifies the 1990 system of highways according to its use, or function, and provides estimates of the costs to provide an adequate system of highways by 1990. A uniform set of standards was used so that reasonable consistency on a nation-wide basis can be achieved. This permits valid comparisons of needs between states so that alternative fiscal policies can be considered.

The principal objective of this Study, in addition to its statutory requirements, is to provide information to the Department of Transportation so that a realignment of the federal-aid highway systems based on functional considerations can be investigated. Specifically, the Federal-aid Highway Act of 1970 calls for the Secretary of Transportation to develop and include:

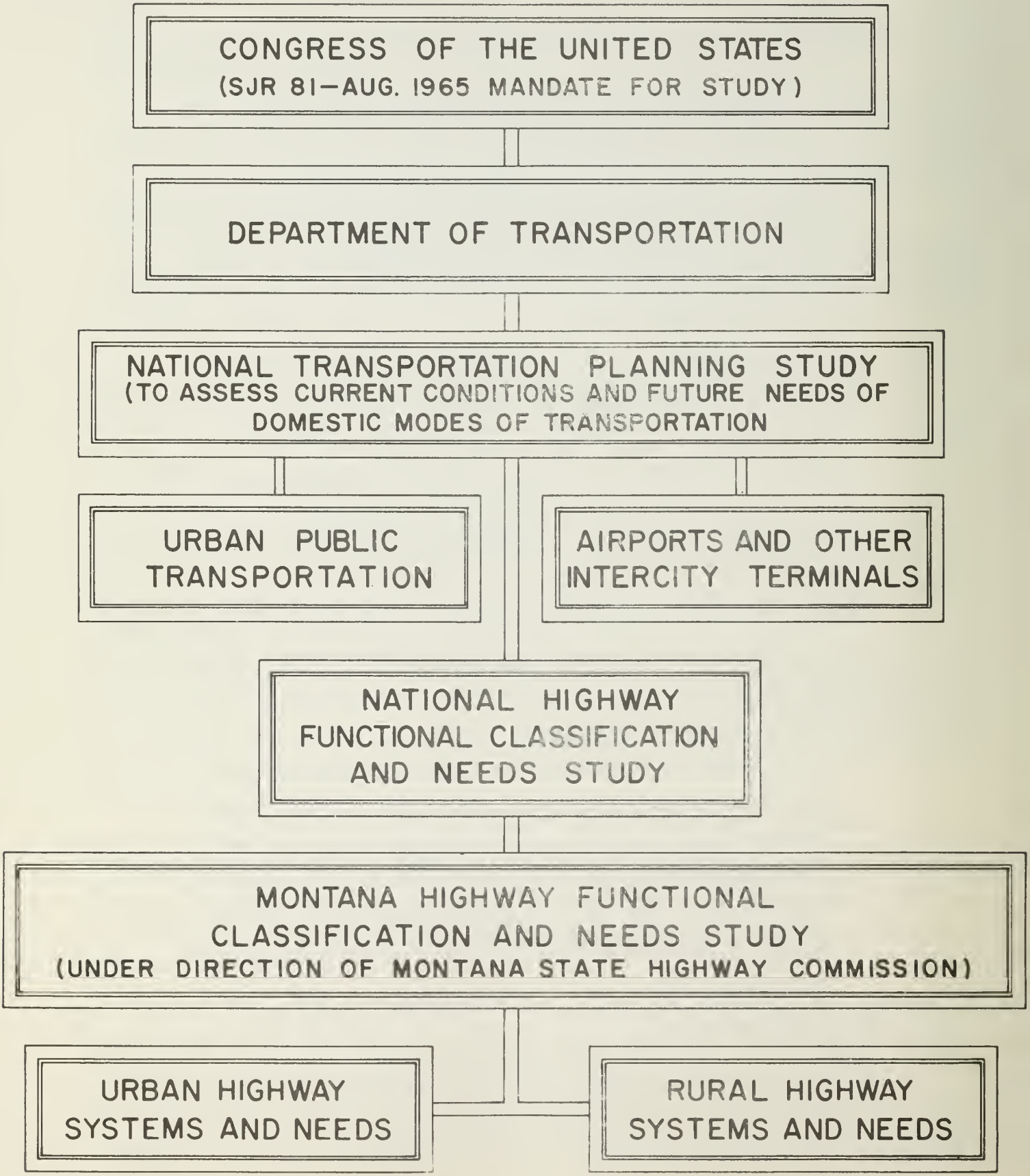
> *'...specific recommendations for the functional realignment of the federal-aid systems. These recommendations shall be based on the functional classification study made in cooperation with the state highway departments and local governments as required by the Federal-aid Highway Act of 1968 and submitted to Congress in 1970, and the functional classification and needs study now underway of the federal-aid systems in 1990.'*

C. Study Organization

Although the Highway Functional Classification and Needs Study is under the jurisdiction of the Department of Transportation–Federal Highway Administration, the state highway departments provided the required information for the Study. It was the decision of the Montana State

Figure No. 1

MONTANA HIGHWAY FUNCTIONAL CLASSIFICATION AND NEEDS STUDY-FLOW OF AUTHORITY


CONGRESS OF THE UNITED STATES
(SJR 81—AUG. 1965 MANDATE FOR STUDY)
DEPARTMENT OF TRANSPORTATION
NATIONAL TRANSPORTATION PLANNING STUDY
(TO ASSESS CURRENT CONDITIONS AND FUTURE NEEDS OF DOMESTIC MODES OF TRANSPORTATION
URBAN PUBLIC TRANSPORTATION
AIRPORTS AND OTHER INTERCITY TERMINALS
NATIONAL HIGHWAY FUNCTIONAL CLASSIFICATION AND NEEDS STUDY
MONTANA HIGHWAY FUNCTIONAL CLASSIFICATION AND NEEDS STUDY
(UNDER DIRECTION OF MONTANA STATE HIGHWAY COMMISSION)
URBAN HIGHWAY SYSTEMS AND NEEDS
RURAL HIGHWAY SYSTEMS AND NEEDS

Highway Commission to engage a consulting engineering firm to do a part of the Study, so that the regular duties of the Highway Commission would not be impaired. The Study results, therefore, are the result of a combined effort of the Montana State Highway Commission, the Federal Highway Administration, and the consulting engineering firm.

D. Responsibilities of Each Agency

The responsibility of the State Highway Commission was to make available to the Consultant all existing information that would be applicable to the Study, do the major portion of the functional classification in the rural areas, code the existing information on the rural worksheets, and provide reviewal of the Consultant's work.

The responsibility of the Consultant was to do the population and urban-in-fact area projections, do the functional classification for the urban areas, develop a sampling procedure for the needs analysis, determine the cost figures to be used, do all necessary field inventory, do the needs and improvement analysis, prepare the necessary forms and maps required for submittal, and prepare a report summarizing the Study.

The responsibility of the Federal Highway Administration was to review and approve the procedures used by the State and the Consultant, provide assistance and advice in areas of question, and insure that the Study was performed in the manner intended so it would be compatible with the results of other states.

This division of responsibility provided 'buffer zones' for reviewal of each phase of the Study, and enabled each agency to be intimately familiar with the developmental procedures during the course of the Study.

PART II

PART II – FUNCTIONAL CLASSIFICATION

I. Introduction to Functional Classification
   - A. General
   - B. Use of 1968 Highway Functional Classification
   - C. Rural Functional Classification
   - D. Urban Functional Classification
   - E. Participation of Local Agencies

II. Population Projections and Ranking of Travel Generators
   - A. Population Projections
   - B. Ranking of Travel Generators

III. Urban–In–Fact Areas
   - A. Development of Urban-In-Fact Boundaries
   - B. Land Use

IV. Procedures in the 1990 Functional Classification
   - A. Functional Classification Procedures–General
   - B. Rural Systems
   - C. Urban Systems

V. Results of the 1990 Montana Highway Functional Classification
   - A. Distribution of Mileages
   - B. Data Summaries and Maps

I. INTRODUCTION TO FUNCTIONAL CLASSIFICATION

A. General

The Functional Classification process is defined as:

> *'...the process by which streets and highways are grouped into classes or systems according to the character of service they are intended to provide.'* (1)

The particular classifications used in this Study, and the characteristics of these classifications, are discussed under *Procedures in the 1990 Functional Classification* in this report.

B. Use of 1968 Highway Functional Classification

The prelude to this Study, the *'1968 Montana Highway Functional Classification Study'*, was used as the base for the 1990 Montana highway functional classification. The changes and/or additions to the 1968 highway functional classification resulted primarily from comprehensive development plans and transportation plans that were completed since the 1968 Study, and from the extensive meetings with local agencies that were held for the 1990 Study. Maximum use was made of available information so that local policies and plans would be reflected in this Study.

C. Rural Functional Classification

The functional classification for the rural highways consisted of a four-step process:

1. The Consultant classified the highways according to procedures set forth by the Federal Highway Administration.
2. The Montana State Highway Commission reviewed the classification and suggested modifications according to their particular needs.
3. The systems were compared to the systems of adjacent states and were made compatible.
4. Local agencies reviewed the systems, particularly the collectors, and suggested modifications.

The final 1990 functional classification of the rural highways, consisting of this input from several sources, is considered to be a system compatible with the objectives of all.

D. Urban Functional Classification

The highway functional classification for the urban areas, as with the rural areas, used the 1968 highway functional classification as a base. The modification of the 1968 highway functional

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(1) National Highway Functional Classification and Needs Study Manual.

classification to a 1990 highway functional classification consisted of first determining 1990 populations and urban boundaries so that proposed developments could be delineated. Then, all available comprehensive and transportation plans were reviewed to determine transportation policy and planned highway improvements of a community. If these improvements could be justified, they were incorporated into the functional classification. The 1990 functional classification of the urban highways resulting from this process was presented to representatives of the communities, and their comments incorporated whenever possible.

E. Participation of Local Agencies

The use of local resources and personnel in the development of information for the Study was not feasible in Montana because of the limited staff available at the local level. However, maximum participation of local agencies was obtained by a series of meetings held throughout the State. Preliminary classifications were sent to representatives of the local agencies, and a meeting held at or near each locality. The purpose and scope of the Study was discussed at the meeting and the functional classification of each urban area and county was reviewed. The representatives of the local agencies were requested to note their comments on functional classification maps made available to them, and send the maps to the Montana State Highway Commission. Much of the input into the Study was obtained in this manner.

An **Advisory Committee** comprised of representatives of several agencies in the State was also formed, and several review meetings were held. The Study requirements and progress were reported at each meeting, questions on the Study were answered, and comments from the participants were noted.

II. POPULATION PROJECTIONS AND RANKING OF TRAVEL GENERATORS

A. Population Projections

As a part of this Study, it was required to forecast the 1990 populations by county and by urban area. The following agencies and sources of information were investigated in estimating these populations.

1. The 1950, 1960, and 1970 Census figures for the State and individual counties.
2. The Upper Midwest Economic Study Urban Report Number 8, *'Projected Urban Growth in the Upper Midwest: 1960–1975'.*
3. All of the available Comprehensive Development Plans in the State done under the provisions of Section 701 of the Housing Act of 1954, as amended.
4. The Comprehensive State Water and Sewer Plans that were available at the time the projections were done.
5. Any individual population estimates and economic studies that could be found.

   Agencies that were consulted included: (1) The Bureau of Business and Economic Research of the University of Montana in Missoula; (2) The Center for Planning and Development of Montana State University in Bozeman; (3) The State Department of Planning and Economic Development in Helena; (4) The Office of Economic Opportunity in Helena; (5) various city planning organizations; and (6) The Bureau of the Census.

It was found that no agency made population projections for all of the counties and urban areas in the State, and that very few projections of any sort could be found. The exceptions were projections for individual counties and urban areas that were done for the Comprehensive Development Plans and the State Water and Sewer Plans, and urban area projections from the Upper Midwest Economic Study.

When the 1970 Census of Population figures became available, it showed that the majority of the available forecasts were overly optimistic. Consequently, the figures that were available were tempered with the knowledge of the 1970 Census, and projections were made that were more compatible with the current Census figures.

Certain assumptions were made in these population projections: (1) the rural population in the eastern farming counties would remain relatively stable; (2) the rural-urban distribution in the western mountainous counties would remain stable; and (3) in general, the major population changes would be in the urban areas.

Populations for the 56 counties were projected independently based upon historical pop-

ulation trends, and any projections available for that county. These projections assumed that the counties which lost population rapidly between 1960 and 1970 had reached relative equilibrium, and would not change in population a great deal between now and 1990. These independent county population projections were factored to equal the Bureau of the Census population projection for the State of Montana that was supplied by the Federal Highway Administration. The 1990 County Population Estimates are shown in Table No. 1, and the 1990 Population Densities by County are shown in Figure No. 2.

Next, the population projections for the urban areas of 2,500 and over were determined. This was done by obtaining an approximate 1970 urban area population from the 1970 Census figures for inside the city limits, and then adding population for the surrounding urban area by counting residences in aerial photographs, and multiplying by 3.5 residents per residence. The 1970 Census showed that the population density figure of 3.5 persons per residence was high. However, a combination of two factors led to a decision not to change the population figures: (1) the population density information was not available until late in the Study, and (2) the difference between the 3.5 figure and the revised density figures was not considered enough to significantly affect the accuracy of the population projections.

The 1970 urban population estimates provided base populations for the urban areas from which population projections could be made from historical trends, and any available projections. These projections were adjusted to provide reasonable and consistent urban-rural population distributions. The total urban-rural distribution independently projected for the State agreed very closely to the population distribution supplied by the Federal Highway Administration. The 1990 urban population estimates are shown in Table No. 2.

Lastly, visitation figures from the major recreation areas in the State were obtained, and estimates made of the anticipated 1990 visitation. These visitation projections were equated into an equivalent population center. The 1990 recreation area visitation estimates and equivalent population as travel generators are shown in Table No. 3.

B. Ranking of Travel Generators

Because population is a good indication of ability to generate traffic, the populations of each urban area, and the equivalent populations of the major recreation areas, were ranked in order of their size and then grouped into divisions of approximately equivalent travel generation potential. This is the first step in determining the type of service for which each group of travel generators is qualified. The 1990 ranking and grouping of travel generators is shown in Figure No. 3.

Other parameters besides population can be used in evaluating a particular area as a

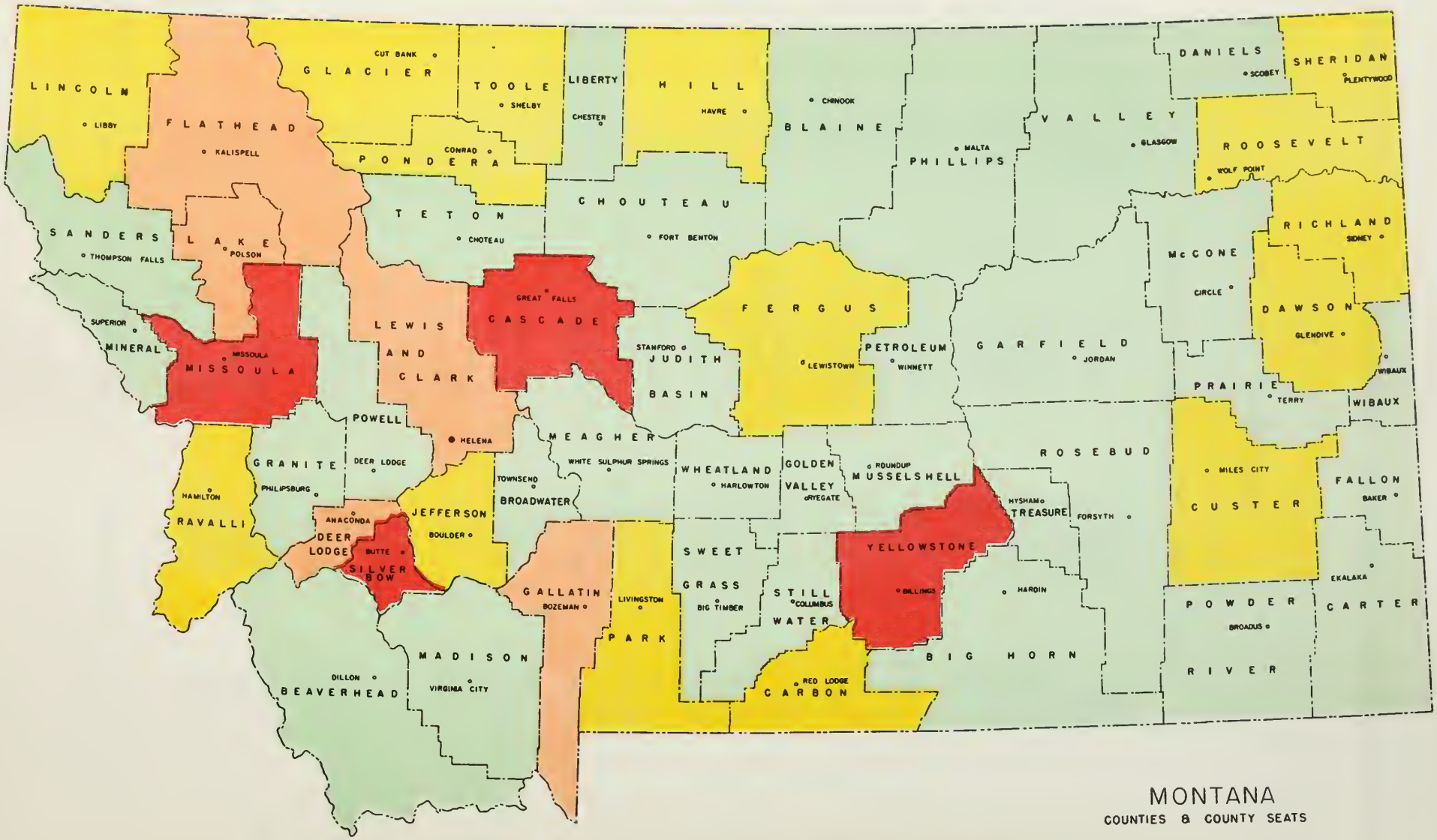
travel generator, but the information available on other parameters (such as retail and wholesale trade) was minimal, and it was decided that the projections of these parameters would be less accurate than if population were used as the only measure of travel generation.

TABLE NO. 1

1990 COUNTY POPULATION ESTIMATES

County	1970 Census	1990 Estimate
Beaverhead	8,187	10,527
Big Horn	10,057	11,053
Blaine	6,727	6,842
Broadwater	2,526	2,632
Carbon	7,080	7,369
Carter	1,956	2,000
Cascade	81,804	111,586
Choteau	6,473	6,842
Custer	12,174	13,685
Daniels	3,083	2,948
Dawson	11,269	11,580
Deer Lodge	15,652	16,843
Fallon	4,050	4,211
Fergus	12,611	13,159
Flathead	39,460	53,687
Gallatin	32,505	45,266
Garfield	1,796	1,790
Glacier	10,783	11,053
Golden Valley	931	947
Granite	2,737	2,842
Hill	17,358	18,422
Jefferson	5,238	6,842
Judith Basin	2,667	2,632
Lake	14,445	16,843
Lewis & Clark	33,281	43,687
Liberty	2,359	2,421
Lincoln	18,063	24,212
McCone	2,875	2,948
Madison	5,014	4,948
Meagher	2,122	2,105
Mineral	2,958	3,053
Missoula	58,263	89,690
Musselshell	3,734	3,684
Park	11,197	11,580
Petroleum	675	684
Phillips	5,386	5,474
Pondera	6,611	6,842
Powder River	2,862	3,158
Powell	6,660	6,948
Prairie	1,752	1,790
Ravalli	14,409	18,949
Richland	9,837	10,001
Roosevelt	10,365	10,737
Rosebud	6,032	6,000
Sanders	7,093	7,369
Sheridan	5,779	5,790
Silver Bow	41,981	47,371
Stillwater	4,632	4,737
Sweet Grass	2,980	2,947
Teton	6,116	6,316
Toole	5,839	6,106
Treasure	1,069	1,053
Valley	11,471	11,580
Wheatland	2,529	2,632
Wibaux	1,465	1,474
Yellowstone	87,367	122,113
TOTALS	694,345	860,000

1990 POPULATION DENSITIES



MONTANA
COUNTIES & COUNTY SEATS

LESS THAN 3 INHABITANTS PER SQ. MI.
3 TO 10 INHABITANTS PER SQ. MI.
10 TO 25 INHABITANTS PER SQ. MI.
MORE THAN 25 INHABITANTS PER SQ. MI.

TABLE NO. 2

1990 URBAN POPULATION ESTIMATES

Urban Area	1968 Estimate	1990 Estimate	Population Change 1968–1990	Per Cent Change 1968–1990
1. Billings	63,537	107,000	+43,463	+68.4%
2. Great Falls	67,183	102,000	+34,817	+51.8
3. Missoula	40,282	77,000	+36,718	+91.2
4. Butte	39,990	41,500	+1,510	+3.8
5. Helena	24,606	35,000	+10,394	+42.2
6. Bozeman	15,929	32,000	+16,071	+100.9
7. Kalispell	17,538	25,000	+7,462	+42.5
8. Havre	12,469	13,500	+1,031	+8.3
9. Miles City	11,065	11,000	−65	−0.6
10. Anaconda	9,474	10,500	+1,026	+10.8
11. Libby	5,814	9,500	+3,686	+63.4
12. Livingston	7,982	7,900	−82	−1.0
13. Lewistown	7,912	7,600	−312	−3.9
14. Glendive	7,902	6,750	−1,152	−14.6
15. Dillon	3,800	6,150	+2,350	+61.8
16. Laurel	5,234	6,000	+766	+14.6
17. Glasgow	8,371	5,200	−3,171	−37.9
18. Sidney	4,564	5,000	+436	+9.6
19. Deer Lodge	5,178	4,650	−528	−10.2
20 Cut Bank	5,158	4,400	−758	−14.7
21. Whitefish	3,065	4,300	+1,235	+40.3
22. Hamilton	2,600	4,200	+1,600	+61.5
23. Wolf Point	3,685	3,600	−85	−2.3
24. Shelby	4,017	3,400	−617	−15.4
25. Polson	2,314	3,200	+886	+38.3
26. Hardin	2,789	3,100	+311	+11.2
27. Conrad	2,665	2,950	+285	+10.7
28. Baker	2,365	2,750	+385	+16.3
TOTALS	387,488	545,150	+157,662	+40.7%

TABLE NO. 3

1990 RECREATION AREA VISITATION ESTIMATES AND EQUIVALENT POPULATION AS TRAVEL GENERATORS

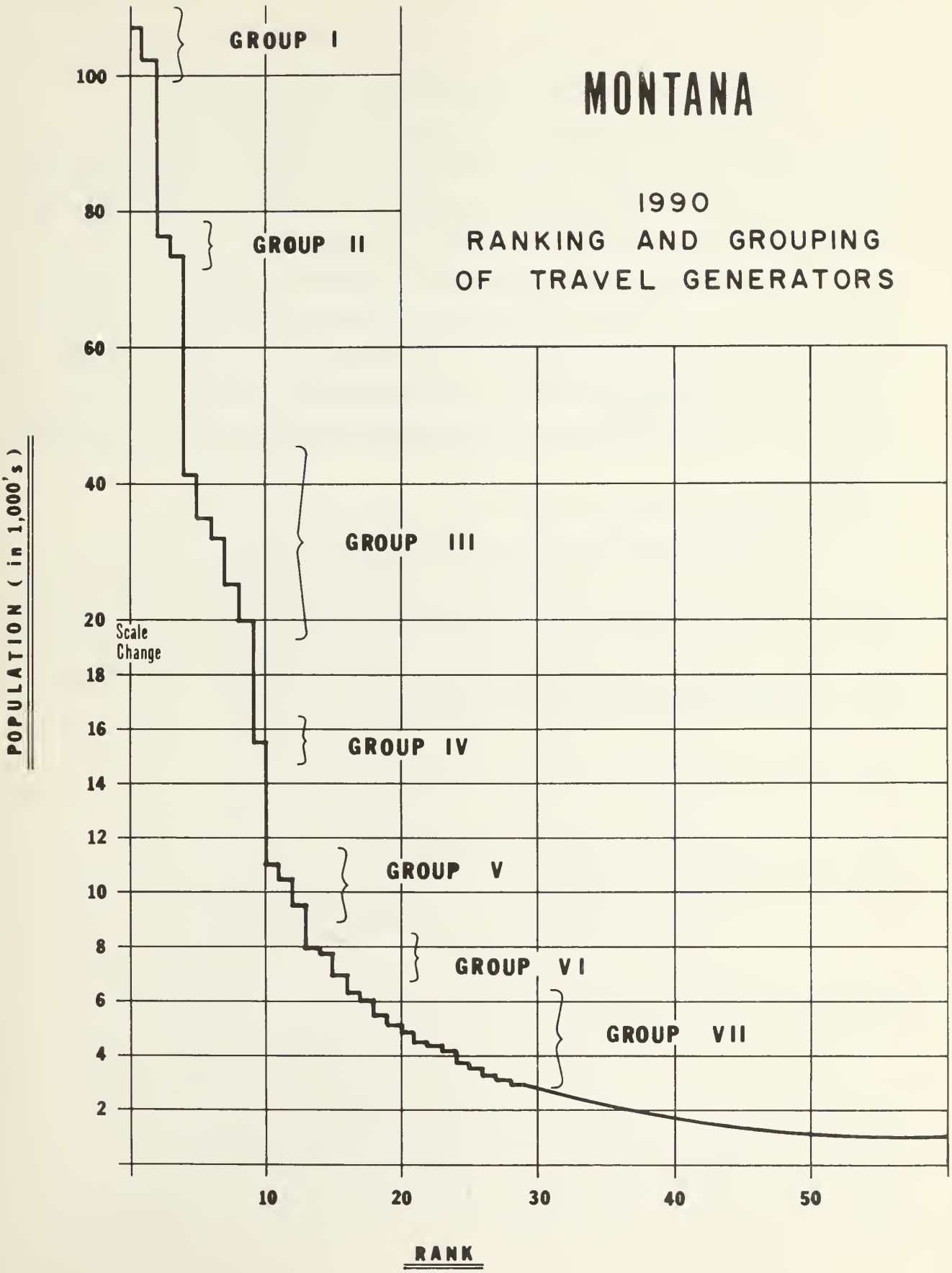
Area	Visitations		Equivalent Population
	1969 Actual	1990 Estimated	1990
Yellowstone	2,230,000*	3,700,000	73,500
Glacier	1,050,000	1,700,000	19,700
Custer	255,000	470,000	2,200
Big Horn Canyon	210,000	340,000**	1,300
Flathead	185,000	305,000**	1,100
Canyon Ferry	150,000	250,000**	760
Lewis & Clark	110,000	180,000**	435
Clark Canyon	25,000	41,000**	***
Makoshika	20,000	33,000**	***
Others	Data not available		

* 1968 figures.

** Yellowstone projection factor applied.

*** Less than 100.

Figure No. 3


MONTANA
1990
RANKING AND GROUPING
OF TRAVEL GENERATORS
GROUP I
GROUP II
GROUP III
GROUP IV
GROUP V
GROUP VI
GROUP VII
Scale Change
POPULATION (in 1,000's)
100
80
60
40
20
18
16
14
12
10
8
6
4
2
10
20
30
40
50
RANK

III. URBAN–IN–FACT AREAS

A. Development of Urban-In-Fact Boundaries

1990 urban-in-fact boundaries were estimated for the 18 urban areas projected to have a 1990 population of 5,000 or greater. In order to be included inside an urban-in-fact boundary, an area must have an anticipated population density of 1,000 or more inhabitants per square mile, or be devoted to an urban use such as airports, parks, factories, cemeteries, or the like.

Preliminary urban-in-fact boundaries were set using the 1968 Study boundaries as a base, and including those areas designated for development in the comprehensive plans. Also, recent aerial photographs were reviewed to determine where new developments were occurring. After preliminary boundaries were set, statistical checks using population densities were applied to each urban area to see if the area change between 1968 and 1990 was justified, and the urban-in-fact boundaries adjusted accordingly.

B. Land Use

To facilitate the type of service to be provided within the urban-in-fact boundaries, land use was delineated on the urban area maps. The land use categories used were residential, commercial, industrial, and public lands. In the urban areas where comprehensive plans were available, the land use could be taken directly from the comprehensive plans. In those areas that did not have comprehensive plans, the type of land use was estimated from aerial photographs.

IV. PROCEDURES IN THE 1990 FUNCTIONAL CLASSIFICATION

A. Functional Classification Procedures—General

Functional classification of highways, the categorizing of highways into systems according to the type of service they provide, is a desirable prerequisite to determining a needs estimate. The 1968 Montana Highway Functional Classification Study, which functionally classified the highways in the State according to their present use, was used as a base for the 1990 highway functional classification. Functional systems were developed for 1990 by starting at the highest functional level of highway and working progressively downward through the levels until the entire system had been classified.

The classification procedures consisted of the following general steps:

1. The 1968 functional classification systems were plotted on 1990 rural and urban maps.
2. Travel generators pertinent to each functional system were added to the maps.
3. The travel generators were connected by travel desire lines showing the relative desire of travel between travel generators.
4. The 1968 systems were examined to see if they satisfied the travel desires, and modified as necessary.
5. The systems were compared with the systems of contiguous states to insure interstate continuity.
6. The Montana State Highway Commission reviewed the systems and made suggestions for improvements.
7. The percent of miles falling in each functional system were calculated and compared to limits suggested by the Federal Highway Administration.
8. A final functional classification system was designated.

B. Rural Systems

The rural highway functional systems are comprised of principal arterials, minor arterials, major and minor collectors, and local roads.

(1) Rural Principal Arterials

Rural principal arterials are the highest level of rural highway functional classification and were developed first. This system of highways is characterized by the longest-trip lengths and heaviest travel densities, and is intended to serve most large urban areas. In addition, this system is an interconnected network of continuous routes without stub

connections. The interstate system is an automatic component of this classification of highway. The percentage guidelines on rural principal arterials, specified by the Federal Highway Administration, are from 2-4 percent of the total rural miles.

The 1990 rural principal arterial system developed for Montana consists of 4.7 percent of the total rural mileage. This is .7 percent above the upper limit of 4 percent specified by the Federal Highway Administration. However, it is felt that the State of Montana consisting of large undeveloped areas having little or no road mileage (almost 30 percent of the State is federally owned of which the vast majority is national park, wilderness and national forest area, or Indian reservation) is a valid exception from the percentage limits. These large areas of little or no road mileages decrease the **number** of total rural miles, which consequently increases the **percent** of rural principal arterial mileage. The rural principal arterial system that was designated is considered to be the minimum highway network required for travel of the type that is specified for this system.

(2) Rural Minor Arterials

Rural minor arterials are the next level of rural highway functional classification. These highways link cities and larger towns not connected by a rural principal arterial, are spaced so that all developed areas of a state are within a reasonable distance of an arterial highway, and provide service to travel of primarily intrastate importance. This system interconnects with the rural principal arterial system and forms an integrated network of arterial highways.

(3) Rural Major and Minor Collectors

Rural major and minor collectors provide service to travel of primarily intracounty importance, with travel lengths and speeds being less than those on the arterial systems. The rural major collectors serve the more important travel generators in the counties such as county seats, consolidated schools, mining areas, etc., and the more heavily trafficked corridors. The minor collectors are primarily for land use and are spaced at intervals consistent with population density, and provide service to the remaining smaller travel generators.

(4) Rural Local Roads

Rural local roads consist of the roads which were not classified under a higher system. Their purpose is to provide land access and service to travel over short distances. The 1990 rural local roads consist of all unclassified existing local roads plus any unclassified frontage roads which will be needed for new highways with access control.

C. Urban Systems

The urban highway functional systems are comprised of principal arterials, minor arterials, collectors, and local streets.

(1) Urban Principal Arterials

Urban principal arterials are the highest type of functional highway in an urban area. These highways serve the major centers of activity, the highest traffic volume corridors, and the longest trip lengths within an urban area, carry a high proportion of the projected travel on a minimum of mileage, and form an integrated network of highways. Connecting links of rural principal and minor arterial highways, (those highways which provide rural-to-rural continuity through an urban area) are automatically classified as urban principal arterials. As with the rural principal arterials, interstate highways are an automatic component of the urban principal arterial system.

(2) Urban Minor Arterials

Urban minor arterials are the second level of highway in the urban functional classification. The urban minor arterials interconnect with and augment the urban principal arterials, provide service to trips of moderate lengths, offer a lower level of travel mobility than urban principal arterials, and serve urban travel generators of moderate importance. Urban connections to all rural major collectors and most rural minor collectors were classified as urban minor arterials.

(3) Urban Collectors

Urban collectors are intended to provide land access service and to channel traffic from local roads to the arterial systems. Minor traffic movements within residential, commercial, or industrial areas are also a function of the urban collector system.

(4) Urban Local Streets

Urban local streets consist of all the remaining highways not on one of the higher systems. The purpose of this system is to provide land access and access to a higher type of highway. 1990 street mileage for each urban area was statistically projected by determining the urban area to be added between now and 1990, multiplying this area by an appropriate factor of miles of local streets per square mile of urban area, and adding this mileage to the local street mileage determined in the 1968 Study.

V. RESULTS OF THE 1990 MONTANA HIGHWAY FUNCTIONAL CLASSIFICATION

A. Distribution of Mileages

The following table summarizes the results of the 1990 Montana Highway Functional Classification for each classification system, and compares the distribution of mileages in each system to the recommended percentage guidelines contained in the Study Manual.

Functional System	Mileage	Percent	Recommended Percent Limits
RURAL FUNCTIONAL SYSTEMS			
Principal Arterials	3,127	4.7%	2–4
Principal Arterials plus Minor Arterials	6,869	10.3	6–12
Major and Minor Collectors	16,272	24.3	20–25
Local Roads	43,847	65.4	65–75
Total Roads	66,988		
URBAN FUNCTIONAL SYSTEMS			
Principal Arterials	255.9	8.9%	5–10
Principal Arterials plus Minor Arterials	502.9	17.6	15–25
Collectors	275.8	9.6	5–10
Local Streets	2,083.4	72.8	Remainder
Total Streets	2,862.1		

As can be noted from the table, the mileages fall within the recommended guidelines except for the rural principal arterials. This deviation was explained under *Procedures in the 1990 Functional Classification* in this report.

Tables No. 4 and 5 show the distribution of mileages by county and urban-in-fact area for 1969 and 1990.

B. Data Summaries and Maps

Certain data summaries and systems maps were requested by the Federal Highway Administration to fulfill the data submittal requirements for the functional classification phase of the Study. The following list of data summaries and systems maps, which meet the requirements of the Federal Highway Administration, are shown in Appendix 'A' in Figures No. 10 through 20, and Maps No. 1 through 9.

Data Summaries

1990 State-wide Area, Population, Mileage and Travel Summary ..... (Figure No. 10)
1990 Rural Data Summary ..... (Figure No. 11)
1990 Rural Supplemental Data Summary ..... (Figure No. 12)
1990 Individual Urbanized Area Data Summary–Billings ..... (Figure No. 13)
1990 Individual Urbanized Area Data Summary–Great Falls ..... (Figure No. 14)
1990 Individual Urbanized Area Data Summary–Missoula ..... (Figure No. 15)
1990 Small Urban Area Data Summary; 25,000–49,999 Population ..... (Figure No. 16)
1990 Small Urban Area Data Summary; 10,000–24,999 Population ..... (Figure No. 17)
1990 Small Urban Area Data Summary; 5,000–9,999 Population ..... (Figure No. 18)
1990 Urban Connecting Link Summary ..... (Figure No. 19)
1990 State-wide Route Log ..... (Figure No. 20)

Systems Maps

Montana 1990 Arterial Systems Map ..... (Map No. 1)
Great Falls Urbanized Area Systems Map ..... (Map No. 2)
Small Urban Area 25,000–49,999 Systems Map ..... (Map No. 3)
Small Urban Area 10,000–24,999 Systems Map ..... (Map No. 4)
Small Urban Area 5,000–9,999 Systems Map ..... (Map No. 5)
Hill County 1990 Highway Functional Classification Map ..... (Map No. 6)
Lincoln County 1990 Highway Functional Classification Map ..... (Map No. 7)
Missoula County 1990 Highway Functional Classification Map ..... (Map No. 8)
Wheatland County 1990 Highway Functional Classification Map ..... (Map No. 9)

The maps that are submitted represent a sample of the total maps prepared. The remaining urban-in-fact and county maps are held on file at the Planning Survey Section of the Montana State Highway Commission, and are available upon request.

Table No. 4

Urban Mileage and Travel

No.	URBAN AREA	Interstate								Other Principal Arterials								Minor Arterials							
		1968		1969		1990				1968		1969		1990				1968		1969		1990			
		Miles	%	DVM	%	Miles	%	DVM	%	Miles	%	DVM	%	Miles	%	DVM	%	Miles	%	DVM	%	Miles	%	DVM	%
	URBANIZED AREAS																								
1.	BILLINGS	4.67	1.5	13,030	1.8	12.95	2.1	159,310	15.8	24.46	7.6	210,418	29.4	48.16	7.8	396,200	39.3	26.90	8.4	138,622	19.4	52.60	8.5	207,600	20.6
2.	GREAT FALLS	4.54	1.6	22,898	3.6	6.40	1.5	89,920	9.5	24.07	8.7	237,701	37.1	31.42	7.5	390,900	41.4	18.50	6.6	79,987	12.5	41.88	10.1	217,100	23.0
3	MISSOULA	2.87	1.2	15,031	2.9	7.56	1.6	111,440	12.3	11.42	4.9	129,712	25.0	19.75	4.2	239,670	26.4	26.95	11.5	114,099	21.9	44.21	9.5	236,900	26.1
	SMALL URBAN 25,000 – 49,999																								
4.	BUTTE	4.99	2.9	16,634	5.9	12.70	4.5	111,900	43.5	10.17	6.0	76,164	26.9	14.35	5.1	64,020	24.9	14.93	8.8	49,237	17.4	17.25	6.1	39,790	15.5
5.	HELENA	2.00	1.4	4,914	2.2	6.61	2.8	35,230	16.4	9.49	6.5	73,189	32.7	15.32	6.6	72,920	34.0	4.65	3.2	21,911	9.8	13.83	6.0	31,560	14.7
6.	BOZEMAN	——		——		3.19	1.8	22,400	11.3	3.92	5.1	34,464	29.6	7.45	4.2	60,850	30.7	5.80	7.6	15,803	13.6	17.15	9.7	34,810	17.5
7	KALISPELL	——		——		——		——		7.81	10.7	63,292	45.3	10.78	8.3	62,250	44.0	6.01	8.3	14,942	10.7	16.38	12.7	15,290	10.8
	SMALL URBAN 10,000 – 24,999																								
8.	HAVRE	——		——		——		——		6.04	10.8	31,382	45.9	6.46	9.3	30,000	44.9	1.91	3.4	3,717	5.4	5.31	7.7	8,100	13.5
9	MILES CITY	——		——		——		——		5.40	8.5	22,990	38.4	6.06	8.4	24,680	52.2	2.47	3.9	6,956	11.6	5.99	8.3	7,620	16.1
10.	ANACONDA	——		——		——		——		5.75	19.2	29,745	59.2	7.01	19.1	36,310	69.4	1.47	4.9	4,303	8.5	2.58	7.0	5,250	10.0
	SMALL URBAN 5,000 – 9,999																								
11.	LIBBY	——		——		——		——		7.19	14.7	34,435	55.0	8.71	15.0	46,660	57.7	4.42	9.1	4,163	6.6	4.56	7.8	6,790	8.4
12	LIVINGSTON	——		——		0.49	1.0	2,990	9.1	3.17	7.9	14,861	36.5	3.22	6.8	16,280	49.3	3.16	7.9	5,387	13.2	3.79	8.1	3,880	11.8
13.	LEWISTOWN	——		——		——		——		4.90	10.0	14,951	33.1	5.34	8.8	19,600	56.4	3.44	7.0	4,885	10.8	5.56	9.2	4,870	14.0
14	GLENDIVE	——		——		1.03	2.2	5,000	15.1	2.43	8.9	11,111	24.7	5.18	11.1	12,580	35.0	2.16	7.9	8,003	17.8	3.32	7.1	4,990	15.1
15.	DILLON	*		*		——		——		*		*		2.51	7.3	9,270	33.5	*		*		2.64	7.7	4,720	17.1
16.	LAUREL	0.62	1.9	1,802	4.7	0.66	1.7	6,270	12.4	4.54	14.1	17,425	45.1	5.22	13.5	16,140	31.9	0.85	2.6	541	1.4	1.32	3.4	2,410	4.8
17.	GLASGOW	——		——		——		——		2.56	7.6	12,227	34.8	3.36	8.8	9,190	54.9	3.26	9.6	4,093	11.7	4.75	12.4	2,060	12.3
18	SIDNEY	*		*		——		——		*		*		4.00	10.1	9,100	40.4	*		*		3.90	9.8	3,200	14.2
19	DEER LODGE	——		——		*		*		1.30	4.8	5,146	22.5	*		*		1.95	7.2	3,418	15.0	*		*	
20	CUT BANK	——		——		*		*		2.28	11.6	7,786	33.7	*		*		1.66	8.4	4,499	19.5	*		*	
	TOTALS	19.69	1.1	74,309	2.4	51.59	1.8	544,460	13.2	136.90	7.9	1,026,909	32.8	204.30	7.1	1,516,620	36.7	130.49	7.6	484,566	15.5	247.02	8.6	836,940	20.3

No.	URBAN AREA	Collector Streets						Local Streets						Total System					
		1968		1969		1990		1968		1969		1990		1968		1969		1990	
		Miles	%	DVM	%	Miles	%	DVM	%	Miles	%	DVM	%	Miles	%	DVM	%	Miles	%	DVM	%
	URBANIZED AREAS																		
1.	BILLINGS	35.69	11.1	101,623	14.2	63.54	10.3	82,700	8.2	228.98	71.4	252,336	35.2	442.00	71.4	163,200	16.2	320.70	18.6	716,029	22.9	619.25	21.6	1,009,010	24.4
2.	GREAT FALLS	25.45	9.2	73,090	11.4	33.13	8.0	88,950	9.4	204.74	73.9	227,261	35.4	303.00	72.9	156,630	16.6	277.30	16.1	640,937	20.5	415.83	14.5	943,500	22.8
3	MISSOULA	19.47	8.3	51,547	9.9	41.92	9.0	114,740	12.6	173.29	74.1	209,681	40.3	353.00	75.7	205,850	22.6	234.00	13.6	520,070	16.1	466.44	16.3	908,600	22.0
	SMALL URBAN 25,000 – 49,999																		
4.	BUTTE	15.33	9.1	31,920	11.3	22.78	8.1	17,910	7.0	123.88	73.2	109,014	38.5	214.00	76.1	23,680	9.2	169.30	9.8	282,969	9.0	281.08	9.8	257,300	6.2
5.	HELENA	12.43	8.5	21,361	9.5	21.62	9.3	21,340	9.9	116.92	80.3	102,422	45.8	175.00	75.3	53,500	24.9	145.49	8.4	223,797	7.1	232.38	8.1	214,550	5.2
6.	BOZEMAN	8.00	10.5	16,175	13.9	15.63	8.9	27,330	13.8	58.73	76.8	49,979	42.9	133.00	75.4	53,010	26.7	76.45	4.4	116,421	3.7	176.42	6.2	198,400	4.8
7	KALISPELL	9.63	13.2	12,950	9.2	17.98	13.9	23,410	16.5	49.29	67.8	48,649	34.8	84.00	65.0	40,550	28.6	72.74	4.2	139,833	4.5	129.14	4.5	141,500	3.4
	SMALL URBAN 10,000 – 24,999																		
8.	HAVRE	3.36	6.0	5,815	8.5	6.36	9.2	7,110	11.8	44.64	80.0	27,454	40.2	51.00	73.8	14,890	24.8	55.95	3.2	68,368	2.2	69.13	2.4	60,100	1.4
9	MILES CITY	4.85	7.6	6,620	11.1	7.22	10.0	6,600	14.0	51.14	80.0	23,320	38.9	53.00	73.3	8,400	17.8	63.86	3.7	59,886	1.9	72.27	2.5	47,300	1.1
10.	ANACONDA	4.41	14.7	7,015	14.0	4.15	11.3	5,210	10.0	18.28	61.2	9,213	18.3	23.00	62.6	5,520	10.5	29.91	1.7	50,276	1.6	36.74	1.3	52,290	1.3
	SMALL URBAN 5,000 – 9,999																		
11.	LIBBY	5.00	10.3	5,249	8.4	5.99	10.3	9,440	11.7	32.17	65.9	18,820	30.0	39.00	66.9	17,960	22.2	48.78	2.8	62,667	2.0	58.26	2.1	80,850	1.9
12	LIVINGSTON	4.32	10.8	4,291	10.6	4.56	9.7	3,680	11.1	29.37	73.4	16,154	39.7	35.00	74.4	6,190	18.7	40.02	2.3	40,693	1.3	47.06	1.7	33,020	0.8
13.	LEWISTOWN	3.04	6.2	6,364	14.1	6.76	11.1	3,910	11.3	37.64	76.8	18,971	42.0	43.00	70.9	6,350	18.3	49.02	2.8	45,171	1.4	60.66	2.1	34,730	0.8
14	GLENDIVE	2.74	10.0	8,047	17.9	5.26	11.2	3,500	10.6	20.06	73.2	17,773	39.6	32.00	68.4	7,010	21.2	27.39	1.6	44,934	1.4	46.79	1.6	33,080	0.8
15.	DILLON	*		*		3.12	9.1	3,790	13.7	*		*		26.00	75.9	9,900	35.8	*		*		34.27	1.2	27,680	0.7
16.	LAUREL	4.25	13.2	6,394	16.6	6.44	16.7	11,710	23.2	21.85	68.2	12,454	32.2	25.00	64.7	14,050	27.8	32.11	1.9	38,616	1.2	38.64	1.3	50,580	1.2
17.	GLASGOW	2.25	6.7	5,722	16.3	3.51	9.2	1,920	11.5	25.73	76.1	13,045	37.2	26.00	68.0	3,570	21.3	33.80	2.0	35,087	1.1	37.62	1.4	16,740	0.4
18	SIDNEY	*		*		5.82	14.7	5,130	22.8	*		*		26.00	65.4	5,070	22.5	*		*		39.72	1.4	22,500	0.5
19	DEER LODGE	2.69	9.9	2,126	9.3	*		*		21.26	78.1	12,139	53.2	*		*		27.20	1.6	22,829	0.7	*		*	
20	CUT BANK	1.25	6.4	2,616	11.3	*		*		14.44	73.5	8,216	35.5	*		*		19.63	1.1	23,117	0.7	*		*	
	TOTALS	275.79	9.6	438,380	10.6	1272.41	73.2	1,176,901	37.5	2,083.00	72.8	795,330	19.2	1723.65	100	3,131,700	100	2861.70	100	4,131,730	100

OVM = Daily Vehicle Miles (Of Travel)
* Not Urban

Rural Mileage and Travel By County

| No. | COUNTY | Interstate 1968 Miles | % | Interstate 1969 DVM | % | Interstate 1990 Miles | % | Interstate 1990 DVM | % | Other Principal Arterials 1968 Miles | % | Other Principal Arterials 1969 DVM | % | Other Principal Arterials 1990 Miles | % | Other Principal Arterials 1990 DVM | % | Minor Arterials 1968 Miles | % | Minor Arterials 1969 DVM | % | Minor Arterials 1990 Miles | % | Minor Arterials 1990 DVM | % | Major Collector 1968 Miles | % | Major Collector 1968 DVM | % | Major Collector 1969 Miles | % | Major Collector 1969 DVM | % | Major Collector 1990 Miles | % | Major Collector 1990 DVM | % | Minor Collector 1968 Miles | % | Minor Collector 1968 DVM | % | Minor Collector 1969 Miles | % | Minor Collector 1969 DVM | % | Minor Collector 1990 Miles | % | Minor Collector 1990 DVM | % | Local Road 1968 Miles | % | Local Road 1968 DVM | % | Local Road 1969 Miles | % | Local Road 1969 DVM | % | Local Road 1990 Miles | % | Local Road 1990 DVM | % | Total System 1968 Miles | % | Total System 1968 DVM | % | Total System 1969 Miles | % | Total System 1969 DVM | % | Total System 1990 Miles | % | Total System 1990 DVM | % |
|---|---|---

PART III

PART III – NEEDS AND IMPROVEMENT ANALYSIS

I. Introduction to Needs and Improvement Analysis
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   - B. Study Sections
   - C. Describing Existing Conditions
   - D. Minimum Tolerable Conditions
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   - A. General
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   - A. General
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   - A. Analysis of Deficiencies
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IX. Summary of Needs and Improvement Analysis

X. Conclusions of the National Highway Functional Classification and Needs Study

I. INTRODUCTION TO NEEDS AND IMPROVEMENT ANALYSIS

A. General

After the highways in the State had been functionally classified, the following step in a highway needs study is to determine the needs on the classified systems, and to determine the types of improvements that will satisfy the needs. Because of the short time allowed for this Study, it was recognized that it was not possible to examine every section of highway in the State. Therefore, the Federal Highway Administration set forth sampling rates to be used in the determination of a state's needs, and a procedure to do the sampling was developed.

B. Study Sections

Since a highway is not homogeneous over its length, and since a sampling procedure was used in determining needs, it was necessary to subdivide highway routes into sections where the physical characteristics would remain relatively constant. Also, if traffic characteristics of the highway changed, or if a rural highway intersected an urban area boundary or corporate boundary, a break was made and a new section started.

C. Describing Existing Conditions

After the highways were divided into study sections and the study sections chosen by the sampling procedure, the existing physical conditions on the study sections were described so that an evaluation of the adequacy of the particular study section in question could be made. Most of the study sections that were on primary or secondary systems could be described from existing records and information. However, for functional systems of highways on off system routes, it was necessary to travel to the study sections and describe the existing conditions from a field inspection.

D. Minimum Tolerable Conditions

The evaluation of the adequacy of a particular study section was done by comparing the existing conditions with a table of minimum tolerable conditions. Tables of minimum tolerable conditions for the functional systems are shown in Tables No. 6, 7, and 8. If the existing conditions did not meet or exceed the minimum tolerable conditions, the section was considered to be inadequate. If the section was adequate now, the existing conditions were projected to see if the section would become deficient sometime in the twenty-year period of 1970–1990, and if so, when.

E. Design Standards

If a study section was determined to be deficient, the next decision was what kind of improvement would be made on the study section to make it acceptable. Tables of design standards for

each functional system of highways (shown in Figures No. 9, 10, and 11) provide a consistent type of improvement for a deficiency.

F. Costs of Improvements

When the deficiency had been identified, and a type of improvement to correct the deficiency had been assigned, the last step was to estimate how much it would cost to construct the improvements. For this purpose, tables of estimated per-mile costs for several construction categories for each design standard were developed. These per-mile costs were applied to the improvement required to arrive at an estimated cost to improve a deficient study section to the appropriate design standard.

Table No.6

Minimum tolerable conditions for rural arterials and collectors

Functional systems	Rural principal arterials	Rural minor arterials			Rural collectors			
ADT for analysis year	All	Over 6,000	2,000-6,000	Under 2,000	1,000-6,000 [1]	400-1,000	100-400	Below 100
Terrain	F R M	F R M	F R M	F R M	F R M	F R M	F R M	F R M
Operating speed (peak hour)	55 50 45	50 45 40	50 45 40	40 40 35	- - -	- - -	- - -	- - -
Surface type	High	High	Inter.	Inter.	Inter.	Low	Low	Gravel
Lane width	11	11	11	11	11	10	9	22' roadway
Shoulder type	Stab.	Stab.	Stab.	Earth	Earth	Earth	Earth	-
Graded right shoulder width (ft.)	8 8 6	8 8 6	6 6 4	6 6 4	4 4 4	4 4 4	2 2 2	-
Safe speed [2]	65 55 45	60 50 40	60 50 40	60 50 40	50 45 35	50 40 30	50 40 30	40 35 25
Stopping sight distance	550 415 315	475 350 275	475 350 275	475 350 275	350 315 250	350 275 200	350 275 200	-
Maximum curvature	5 6 10	5 8 13	5 8 13	5 8 13	8 10 18	8 13 23	8 13 23	-
Maximum gradient [3]	3 4 8	3 5 9	3 5 9	3 5 9	4 5.5 10	4 6 11	4 6 11	-
Number of lanes	[4]	[4]	2	2	2([1])	2	2	-
Pavt. cond. rating (PSR or equivalent)	2.6	2.6	2.1	2.1	2.1	2.1	2.1	-
Railroad crossing protection	See Table III-15							
Structures:								
Width (ft.) [5]	Traveled way width + 6 ft	Traveled way width + 4 ft.			Traveled way width + 2 ft.			18 18 18
Vertical clearance (ft.)	14	14	14	14	14	14	14	14
Loading	H-20	H-20	H-15	H-15	H-15	H-15	H-15	H-15

[1] Rural collectors with present ADT above 6,000 should be multilane where necessary to maintain peak hour operating speeds of 40, 35, and 30 in flat, rolling, and mountainous terrain respectively.
[2] Approximate speed on which minimum tolerable stopping sight distance, curvature, and gradients are based.
[3] Steeper grades may be considered tolerable if lengths are relatively short or climbing lanes are provided.
[4] As necessary to maintain the operating speed specified.
[5] For bridges over 250 ft. in length, widths 4 ft. less than shown, but in no case less than the width of the approach traveled way, will be considered tolerable.

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Table No. 7

Minimum tolerable conditions for urban arterials

Functional system	Freeway/expressway (Uninterrupted flow)		Other urban principal arterial	Urban minor arterial
Type of area	Built up area	Outlying area		
Operating speed (peak hr.)	35	40	-	-
V/C ratio (peak hr.)	-	-	0.85	0.90
Lane width (ft.)	11	11	10	10
No. of lanes	1/		2/	2/
Surface type	High		High	Intermediate
Graded right shldr. width (ft.)	8	8	6' on uncurbed sections	
Shoulder type	Surfaced		Stabilized	
Median protection	3/		-	-
Cross section 4/	-	-	Curbs, gutters, & enclosed drainage	
Safe speed 5/	-	-	35	30
Pavement condition rating	2.6	2.6	2.6	2.1
Railroad crossing protection	See Table III-15			
Structures:				
Width (ft.)	Traveled-way width + 6 ft		Curb-curb width of approach roadway 6/	
Vertical clearance (ft.)	14	14	14	14
Loading	H-20	H-20	H-15	H-15

1/ As necessary to maintain minimum operating speed specified.
2/ Overall street width as required to maintain maximum v/c ratio.
3/ Positive type median protection unless width is at least 30 ft.
4/ An open ditch section on arterial streets in outlying areas with less than 50% development is tolerable.
5/ This item is applicable to at grade streets in outlying sections of urban areas where travel speeds are such that alignment becomes an important consideration. The lengths of critical curves and/or sight distance situations will be evaluated in determining needs.
6/ Where a shoulder rather than curbed section is tolerable, the structure width should be at least the traveled way width plus four ft.

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Table No. 8

Minimum tolerable conditions for urban collector streets

Surface width	Sufficient traffic lanes to restrict congestion (v/c >0.9) to a relatively short daily period. A capacity analysis is not warranted unless ADT exceeds 7,000.
Lane width (ft.)	10
Cross section	On uncurbed sections at least a 5 ft. shoulder should exist with a ditch adequate to carry all but extremely heavy rainfall. Where adjacent area is more than 50% developed, a curbed section should exist.
Safe speed (mph) 1/	25
Surface type	Low
Pavement condition (PSR or equivalent)	2.1
Railroad crossing protection	See Table III-15
Structures:	
Width (ft.)	Prevailing width of travel way
Vertical clearance (ft.)	14
Loading	H-15

1/ This item is applicable to collector streets in outlying sections of urban areas where travel speeds are such that alignment becomes an important consideration. The number of critical curves or sight distance situations will be evaluated in determining needs.

Table No. 9

Design standards for rural arterials and collectors

Functional systems	Principal arterials			Minor arterials						Collectors											
ADT	All			Design year above 2,000			Design year under 2,000			Design year above 2,000			Design year 800-2000 Cur. above 400			Current 250 - 400			Current below 250		
Design standard number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Terrain	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M
Minimum design speed (mph)	70	70	50	70	60	50	70	60	50	60	60	40	60	50	40	60	40	30	50	40	30
Access control	See page III-130						-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Median width (ft.) 1/	64	64	16	40	40	16	-	-	-	40	40	16	-	-	-	-	-	-	-	-	-
Lane width (ft.)	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	11	11	11	10	10	10
No. of lanes	Table III-10			Table III-11			2	2	2	Table III-11			2	2	2	2	2	2	2	2	2
Graded shoulder width (ft.) 2/	12	10	8	10	10	8	8	8	2	8	8	6	6	6	6	4	4	4	4	4	4
Surface type 3/	High Surfaced 4/			High Stabilized 4/			Intermediate Stabilized 4/			High Stabilized 4/			Intermediate --- 4/			Low --- 4/			Low --- 4/		
Shoulder type 3/																					
Right of way width (ft.)																					
Railroad crossing protection	See Table III-15																				
Structures:																					
Width (ft.)	Full width (surface and shoulders). Exceptions in accordance with AASHO standards.																				
Vertical clearance (ft.) 5/	16			16			16			16			16			16			16		
Loading	HS20-44			HS20-44			HS20-44			HS20-44			HS20-44			HS15-44			HS15-44		

1/ Applicable to multilane facilities only.
2/ Provide four foot left shoulder on divided facilities.
3/ See Table III-14 for surface and shoulder type definitions.
4/ As necessary for the type of construction proposed, giving due consideration to the recommendations pertaining to slopes and recovery areas in the 1967 AASHO "Yellow Book" (Highway Design and Operational Practices Related to Highway Safety).
5/ Plus allowance for resurfacing.

Table No. 10

Design standards for urban arterials

Functional systems	Freeways and expressways		Other principal arterials		Minor arterial streets	
Type of area	Built up area	Outlying area	Built up area	Outlying area	Built up area	Outlying area
Design standard number	22	23	24	25	26	27
Design speed (mph)	60	70	40	50	30	40
Access control	See page III-32		See page III-32		—	—
Median width (ft.)	24 1/	64 1/	2/	2/	2/	2/
Lane width	12	12	12	12	12	12
No. of travel lanes	See Table III-12		See Table III-13		See Table III-13	
Graded rt. shldr. width (ft.)	12	12	—	—	—	—
Graded lt. shldr. width (ft.)	6 3/	6 3/	—	—	—	—
Curb parking lane	—	—	4/	4/	4/	4/
Surface type (incl. parking lanes) 5/	High		High		High	
Shoulder type 5/	Surfaced		—	—	—	—
Cross section	—	—	Curbs, gutters, sidewalks and enclosed drainage.			
Right of way width	6/	6/	6/	6/	6/	6/
Railroad crossing protection	See Table III-15					
Structures: Width	Full width (surface & shoulders) 7/		Curb to curb width of approach plus sidewalks where necessary			
	Exceptions in accordance with AASHO Standards					
Vertical clearance (ft.)	16		16		16	
Loading	HS 20-44		HS 20-44		HS 20-44	

1/ Lesser widths with suitable median barrier acceptable where economy dictates.
2/ Minimum of 6 ft. on principal arterials. At least 16 ft. where ROW is available and left turn lanes are to be provided.
3/ Left shoulder should be 10 ft. where 3 or more through lanes are required in each direction.
4/ Parking lanes 10 ft. wide should be provided on both sides of 2 and 4 lane facilities. On 6 lane sections, the curbs should be offset 2 feet from the travel lane.
5/ See Table III-14 for surface and shoulder type definitions.
6/ As necessary for the type of construction proposed, giving due consideration to the recommendations pertaining to slopes and recovery areas in the 1967 AASHO "Yellow Book" (Highway Design and Operational Practices Related to Highway Safety).
7/ Where the median width is 30 ft. or less, the estimate should include the cost of a single structure rather than parallel structures.
8/ Plus allowance for resurfacing.

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Table No. 11
Design standards for urban collector streets

Design Year ADT	12000 and above	6000 - 12000	Under 6000
Design standard number	28	29	30
Design speed (mph)	30	30	30
Number of travel lanes	4	4 or 2 1/	2
Lane width (ft.)	12		
Median width (ft.)	16 if left turns lanes provided		
Curb parking lane	2/		
Surface type including parking lanes 3/	Intermediate or high		
Cross section	Curb, gutters, sidewalks and enclosed drainage		
Stopping sight distance (ft.)	200		
Maximum gradient	5% in flat terrain, 7% in rolling terrain		
Right of way width (ft.)	4/		
Railroad crossing protection	See Table III-15		
Structures:			
Width	Approach travel way plus 6 ft. and sidewalks		
Vertical clearance (ft.) 5/	14		
Loading	HS20-44		

1/ Determine number of lanes based on a capacity analysis.
2/ In residential areas 8 ft. parking lanes should usually be provided on one or both sides. In commercial and industrial areas 10 ft. parking lanes should be provided on both sides.
3/ See Table III-14 for surface type definitions.
4/ As necessary for the type of construction proposed.
5/ Plus allowance for resurfacing.

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II. SAMPLING PROCEDURES FOR HIGHWAY NEEDS EVALUATION

A. General

The evaluation of needs for the 1990 functionally classified systems of highways, excluding the interstate system, was done on a sampling basis as directed by the National Highway Functional Classification and Needs Study Manual.

For the interstate system, a sampling procedure was not needed because it was necessary to examine the entire system for needs requirements. The needs for the interstate system that were to be reported were those needs accruing between 1970 and 1990 that were not already reported in the 1970 Interstate Cost Estimate.

For the remaining systems, sampling procedures were developed individually for rural areas small urban areas, and urbanized areas. The following discussion presents the methods that were developed and the required rates of sampling for each of these areas.

B. Rural Areas

In an investigation to determine areas of the State where uniform costs occur, it was found that the State of Montana could be divided into two cost areas; a western area with mountainous terrain prevailing, and an eastern area with rolling terrain prevailing. The western cost area contains 19 counties and the eastern cost area 37 counties.

In an effort to determine homogeneous areas for sampling, it was decided that the State could logically be divided into six sampling areas. The western cost area served as two sampling areas, while the eastern cost area was separated into four sampling areas. This resulted in relatively uniform sampling areas; four of which contained nine counties and two of which contained ten counties (see Figure No. 4).

The needs appraisal on rural principal arterials was made on representative samples of each rural principal arterial route. To obtain these representative samples, each route within a sample area was divided into the sections that are reported in the 1969 *Sufficiency Rating* report of the Montana State Highway Commission. Every other section was selected from these route sections.

The remainder of the rural functional systems were sampled on a cluster sampling basis by county units. The counties falling within a sample area were grouped, and sample counties selected randomly from the group until the mileage requirement for the minor arterial system was satisfied. Then, the counties that were sampled for the minor arterial system were grouped, and sample counties chosen from this group until the mileage requirement for collectors was satisfied. Lastly, the counties that were sampled for the collector system were grouped, and sample counties chosen

from this group until the mileage requirement for local roads was satisfied. This method yielded maximum reliability with a minimum of duplication and effort.

The minimum sampling rates required by the Federal Highway Administration and the actual sampling rates used for the rural systems are as follows:

Rural System	Percent of 1990 System Miles	
	Minimum	Sampled
Completed Interstate	100%	100.0%
Other Principal Arterials	50%	51.8%
Minor Arterial Roads	25%	26.0%
Collector Roads	10%	13.1%
Local Roads	5%	5.6%

C. Small Urban Areas

For the small urban area principal arterials, each principal arterial route within a particular urban-in-fact area was divided into a number of homogeneous sections. From these sections, every other section was chosen for the sample. This procedure was chosen because it was felt that there was enough difference in the principal arterials of different small urban areas to warrant sampling a portion of each principal arterial. As with the rural principal arterials, the number and length of the sections depended upon the length and homogeneity of the principal arterial within the small urban area.

While it would have been desirable, in the remaining functional systems of small urban areas, to use each individual small urban area as a separate sampling unit and a cluster sampling technique, it was not feasible in the State of Montana because of the small universe available for each small urban area population stratum. For the purpose of increasing these universes, the small urban areas in each stratum were divided into approximately equal quadrants as judged by the highway mileage. This enlarged the available discrete universes of each small urban area population stratum by a factor of four, and permitted the use of random cluster sampling.

The sampling procedure followed for these systems was to first group the small urban areas into population strata of 5,000–9,999; 10,000–24,999; and 25,000–49,999. Then, each small urban area was divided into quadrants. All of the quadrants in a population stratum were grouped to provide a universe for that stratum. From this universe, the samples required for the minor arterial streets were randomly selected. Then, the quadrants that were sampled for the minor arterial streets were grouped, and sample quadrants randomly selected until the mileage requirements for the col-

lector streets were satisfied. Lastly, the quadrants sampled for the collector system were grouped, and sample quadrants randomly selected until the mileage requirements for the local system were satisfied.

The minimum sampling rates required by the Federal Highway Administration and the actual sampling rates used for small urban area systems are as follows:

Small Urban Area Systems	Percent of 1990 System Miles	
	Minimum	Sampled
Completed Interstate	100%	100.0%
Other Principal Arterials	50%	57.1%
Minor Arterial Streets	25%	27.1%
Collector Streets	10%	11.6%
Local Streets	5%	6.0%

D. Urbanized Areas

Each urbanized area was treated separately in the sampling process. The urbanized area principal arterials, minor arterials, and collectors were sampled by a process similar to that used for small urban area principal arterials. Each route was divided into logical sections, the number and length of sections dependent upon the length and homogeneity of each route. For the urban principal arterials, alternate sections were chosen. For the urban minor arterials and collectors, all study sections in an urbanized area were numbered. Every fourth section of the urban minor arterials and every tenth section of the urban collectors were chosen for the sample sections. This process was chosen because of the self-evident improved reliability of estimating needs from a portion of each route.

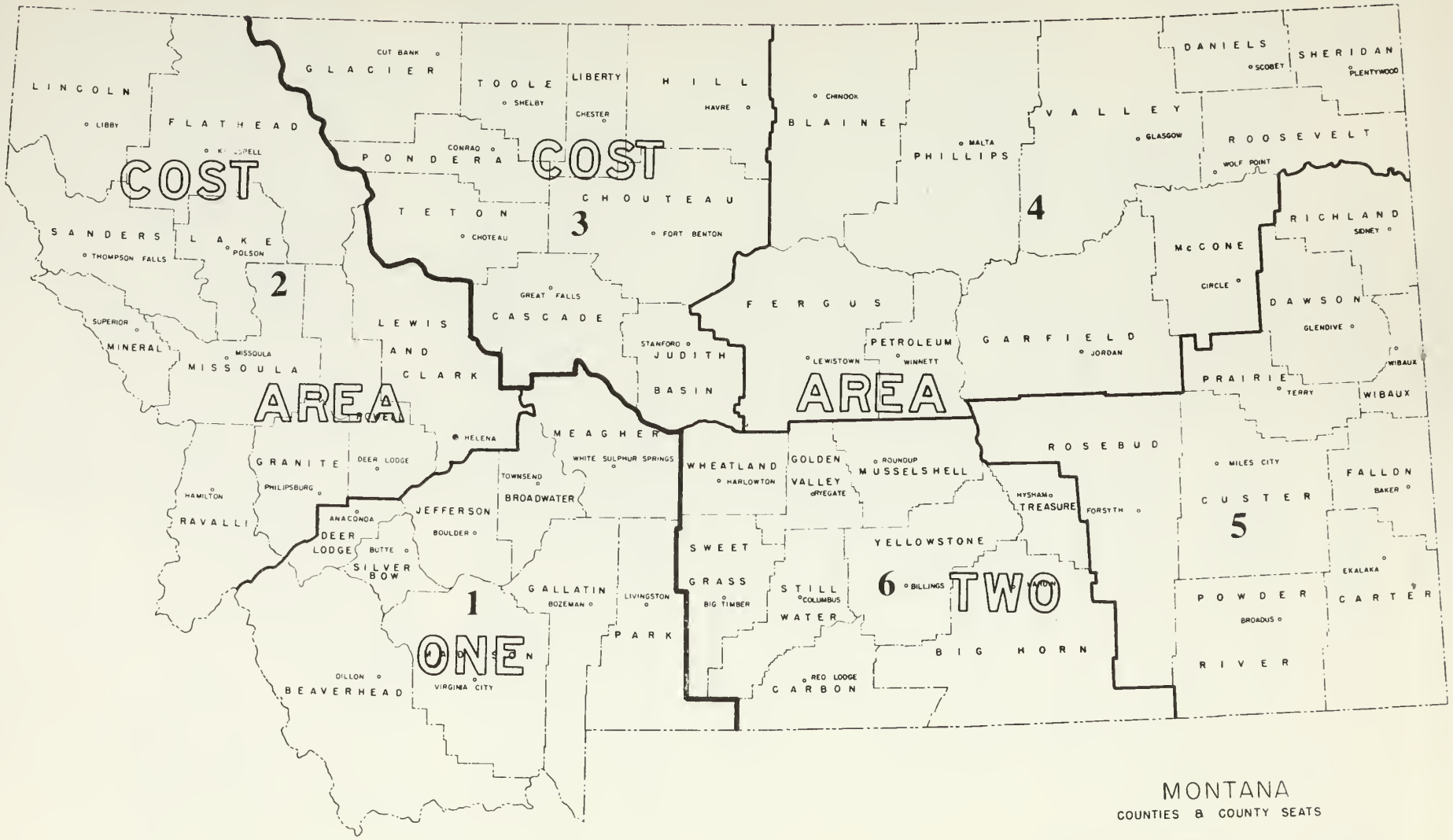
For the sampling of local streets in urbanized areas, each urbanized area was first divided into a number of definable zones. These zones were numbered, and the numbered zones randomly selected until the local street mileage in the selected zones satisfied the required sample mileage for the local streets in each urbanized area.

The minimum sampling rates specified by the Federal Highway Administration and the actual sampling rates used for urbanized area systems are as follows:

Urbanized Area System	Percent of 1990 System Miles	
	Minimum	Sampled
Completed Interstate	100%	100.0%
Other Principal Arterials	50%	55.9%
Minor Arterial Streets	25%	29.3%
Collector Streets	10%	11.4%
Local Streets	5%	7.7%

Figure No.4

RURAL SAMPLING AREAS



MONTANA
COUNTIES & COUNTY SEATS

RURAL SAMPLING AREAS
1 thru 6

III. DESCRIBING EXISTING CONDITIONS ON STUDY SECTIONS

A. General

The study sections selected for sampling were inventoried to determine the existing conditions on each section prior to making an analysis of the adequacy of each section. If information on existing conditions was available from the State's records, this information was utilized. If no information was available, a field inventory was conducted and the existing conditions recorded.

B. Describing Existing Conditions on Rural Highways

The existing conditions of the rural functional systems which coincided with federal-aid primary and secondary highways could be determined directly from Planning Survey records. On those functional systems which were on off-system roads, a field investigation was made. The arterial systems, for the most part, fell on existing system routes and could be coded in the office, while the collectors generally were on off-system routes and required field inventories. The local roads did not require information as extensive as the higher systems, and could be coded in the office from the State's local road inventory records. The adequacy of the existing records for local road analyses was determined by a trial field inventory comparing recorded information with actual conditions. The field trial showed that existing information was sufficiently accurate.

C. Describing Existing Conditions on Urban Highways

The existing conditions on urban highways for functional systems on federal-aid highways were coded from both existing information and field inventories. Physical information was available from Planning Survey data, but traffic information such as traffic signal cycle times and speed limits required a field inventory. On off-system roads, all existing condition information was obtained from field inventories.

D. Coding of Information

Information describing the existing conditions of each study section was coded on worksheets provided by the Federal Highway Administration. Figure No. 5 shows the worksheet used for the rural arterials and collectors. The worksheet for the urban arterials and collectors is similar. The descriptions consisted of information on road-way cross-section, pavement condition, alignment, and traffic. From the items coded, a reasonably complete picture of the existing condition of a study section could be obtained.

Figure No. 5

RURAL ARTERIAL AND COLLECTOR WORKSHEET

CARD 1

IDENTIFICATION

	Columns
1. State	1-2
2. County	3-5
3. Route Number	6-9
4. Route Section	10-12
5. Subsection Number	13-14
6. Length (0.1 mile)	15-17
7. 1968 Functional Classification	18
8. 1990 Functional Classification	19

Code ('68 and '90)	Functional System
1	Interstate
2	Other Principal Arterial
3	Minor Arterial
4	Major Collector
5	Minor Collector
6	Local ('68 Only)
7	Did Not Exist ('68 Only)

9. Federal-aid System (1 FAP, Including Interstate, 2 FAS, 3 Non FA, 4 New)	20
10. Jurisdictional Responsibility (1 State, 2 Federal Domain, 3 Toll, 4 Other Existing, 5 New)	21

EXISTING CONDITIONS (1970)

Geometrics

11. Access Control (Full 1 | Partial 2 | None 3)	22
12. Lane Width (feet)	23-24
13. Number of Lanes	25-26
14. Shoulder Width (feet) ____ Right	27-28
____ Left	29-30
15. Terrain (Flat 1 | Rolling 2 | Mountainous 3)	31
16. Percent of Length with Intolerable Safe Speed	32-33
17. Percent of Length with Sight Distance ≥ 1500 feet	34-36
18. Median Width (feet)	37-38
19. Average Highway Speed (mph)	39-40
20. Number of Signals and/or Stop Signs	41-42
21. Type of Development (Rural 1 | Dense 2)	43
22. Available Right-of-Way ____ feet	

Traffic

23. ADT	44-49
24. Percent Trucks	50-51
25. K Factor (DHV/ADT)	52-53
26. Directional Factor	54-55
27. Capacity (hourly)	56-60
28. Operating Speed (mph)	61-62

Structural

29. Surface Type	63

1	High-Flexible
2	High-Rigid
3	Intermediate
4	Low
5	Gravel
6	Graded & Drained

30. Pavement Section	64

'SN' Known	'D' Known	Heavy	Medium	Light
1	2	3	4	5

Structural Number (SN) or Slab Thickness (D)	65-66
31. Pavement Condition (PSR or equivalent - 0.0)	67-68
32. Shoulder Type (Surfaced 1 | Stabilized 2 | Earth 3)	69
33. Drainage Adequacy (Good 1 | Fair 2 | Poor 3)	70
CARD NUMBER [1]	80

REMARKS: _____

CARD 2

ANALYSIS OF DEFICIENCIES

	Columns
1-5 Identification (Repeat card 1)	1-14
34. 1990 ADT	15-20
35. Average Annual Traffic Growth ____ %	
36. Percent of Length with Intolerable Safe Speed (1990)	21-22
37. Time of Pavement Condition Deficiency (Now 1 | 1-5 2 | 6-10 3 | 11-15 4 | 16-20 5 | 20 6)	24

38. Deficiencies:

	Code	Now	1-5	6-10	11-15	16-20	20
Operating Speed	1						
Lane or Roadway Width	2						
Safe Speed	3						
Pavement Type and/or Condition	4						
Shoulders	5						
None	6						

39. Initial Deficiency Code	25
40. Secondary Deficiency Code	26
41. Period Section Becomes Deficient (Now 1 | 1-5 2 | 6-10 3 | 11-15 4 | 16-20 5 | 20 6)	27

DESCRIPTION OF IMPROVEMENT

42. Year of Improvement	28-29
43. ADT First Year After Improvement	30-35
44. Type of Improvement	36

0	No Improvement
1	New Location
2	Reconstruction
3	Isolated Reconstruction
4	Major Widening
5	Minor Widening
6	Resurfacing and Shoulder Improvement
7	Resurfacing

45. Design Year ADT	37-42
46. Design Standard Number	43-44
47. Access Control (Full 1 | Partial 2 | None 3)	45
48. Number of Lanes	46-47

RAILROAD CROSSINGS

Number of RR Crossing With:	Present	1990	
49. No Protective Devices			48
50. Cross Bucks			49-50
51. Flashing Lights			51-52
52. Flashing Lights and Gates			53-54
53. Grade Separations			55-56

STRUCTURES

54. Number of Structures (Present)	57-58
Number of Deficiencies (Existing Structures):	
55. Width	59-60
56. Vertical Clearance	61-62
57. Loading	63-64
58. Other	65-66
59. Number of New Structures Needed	67-68
60. Time of Structure Needs (Now 1 | 1-5 2 | 6-10 3 | 11-15 4 | 16-20 5 | 20 6)	69
CARD NUMBER [2]	80

CARD 3

COSTS, Thousands

	Columns
1-5 Identification (Repeat card 1)	1-14
61. Right-of-Way	15-20
62. Grading & Drainage	21-26
63. Surface & Base	27-30
64. Other	31-34
65. Structures (incl. RR Grade Sep.)	35-40
66. Maintenance	41-44
67. Administration	45-48
68. Total	49-54
69. Cost Area	55-56
70. Expansion Factor (00.00)	57-60
CARD NUMBER [3]	80

REMARKS: _____

IV. ESTIMATING UNIT AND PER–MILE COSTS

A. General

Estimates of the costs of the needed improvements that were defined in the needs and improvement analysis phase are an integral and important part of this Study. It was necessary to develop an average cost per mile for several construction categories as a function of cost area, type of improvement, terrain, traffic and functional classification. The cost analysis involved the following steps:

1. Cost areas, where the costs of construction items varied as a result of geographic location, were determined.
2. Average costs per mile for each type of improvement for the construction categories of: base and surfacing, grading and drainage, and 'other' costs were developed.
3. Average costs per mile for right-of-way acquisition and utility adjustments developed.
4. The structure costs, on a square-foot basis, were estimated for various types of structures.
5. Preliminary and construction engineering costs were determined and prorated into the costs of construction.

B. Information Used to Develop Costs

All of the costs used in the needs appraisal were developed from actual projects constructed within Montana in 1968 and 1969. For the most part, the data used was taken from state highway projects; however, the urban analysis also involved S.I.D. bid tabulations from several cities within the state. The following outline shows the type and extent of the information used in each of the five steps employed in preparing the cost estimate.

(1) Determining Cost Areas

(a) The cost areas were determined from data taken from the 1968 and 1969 *Detail Estimates* furnished by the State Highway Commission's Planning Survey Section. These estimates provided the quantity and successful bid price for every cost item associated with a project, and were used throughout the entire cost analysis. Data was taken from detail estimates for 47 F.A.I. projects, 43 F.A.P. projects, and 28 F.A.S. projects. These 118 projects represent some 365 miles of actual construction and over 95 million dollars in construction costs.

(2) Developing Average Costs Per Mile

(a) The same detail estimates mentioned above were used for base data.

(b) S.I.D. bid tabulations from Helena, Great Falls, Billings, Missoula, Bozeman, and Havre were used as supplemental data for the urban areas.

(3) Right-of-Way and Utility Adjustment Costs

(a) An average cost per acre for a number of right-of-way categories was provided by the State Highway Commission's Right-of-Way Division.

(b) Numerous plans of projects constructed within the last few years were used to determine the average amount of right-of-way take required for different class roadways.

(4) Structure Costs

(a) The average cost per square foot for various types of structures based on 1969 prices was provided by the State Highway Commission's Bridge Division.

(5) Preliminary and Construction Engineering Costs

(a) This analysis was based on records provided by the State Highway Commission's Accounting Division.

C. Development of Unit and Per-Mile Costs

A detailed description of the procedures used in developing the unit and per-mile costs and tables of the per-mile costs are contained in Appendix 'B'.

V. ESTIMATING NEEDED IMPROVEMENTS

A. Analysis of Deficiencies

The method used for determining deficiencies in this Study was to compare the existing conditions of each study section with a set of standards that was considered to be the minimum tolerable condition. If the existing condition of the section of highway did not meet the minimum tolerable conditions of the functional system under analysis, the section of highway was considered deficient now. If the section of highway met or exceeded the minimum tolerable conditions, then the highway was considered sufficient for the present time. Traffic and remaining pavement life were then estimated on five-year increments to see if the highway would become deficient sometime in the twenty-year period, and if so, when.

B. Description of Improvement

When a section was found to be deficient, the type of improvement that would best correct the deficiency was determined from a series of improvement analysis guides. Figure No. 6 shows the improvement analysis guide for the rural principal arterials. Following the guides and answering the questions pertaining to the characteristics of the study section, the required type of improvement was determined. The improvement types specified for this study are: new location; reconstruction; isolated reconstruction; major widening; minor widening; resurfacing; and resurfacing with shoulder improvements.

C. Railroad Crossings

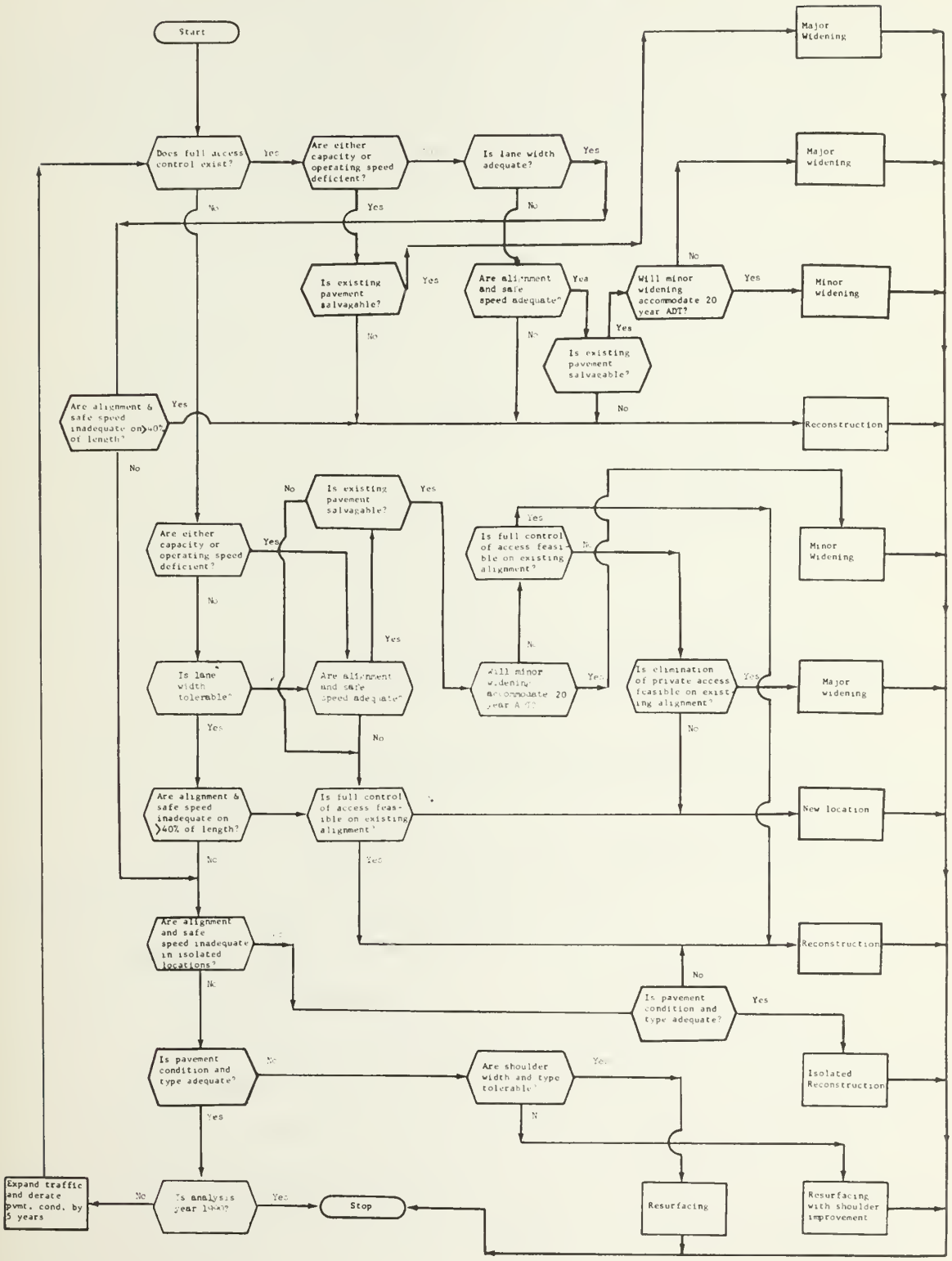
Railroad crossings for both urban and rural functional systems were analyzed to determine if the type of crossing currently existing would be adequate for 1990. This was done by computing an exposure factor (1990 ADT times the number of trains) and using this exposure factor in determining the type of protection required. Criteria for determining the type of railroad crossing needed in a particular functional system for several ranges of exposure factors was provided by the Federal Highway Administration.

D. Structures

Structures were handled in much the same way as the highway sections in determining deficiencies. Existing conditions were compared with the minimum tolerable conditions, and the structures which did not meet these conditions were considered deficient. Improvements for structures, however, were estimated on the square feet of structure improvements needed rather than on a per-mile basis, because of the wide variance in structure types, and the specialized nature of each structure improvement.

Figure No. 6

IMPROVEMENT ANALYSIS GUIDE FOR RURAL PRINCIPAL ARTERIALS



E. Costs of Improvements

Once the type of improvement was assigned to a deficient facility, the remaining step was to estimate the cost of the improvement. Per-mile costs from the cost tables were applied to the appropriate type of improvement, and multiplied by the length of the study section to give a total cost for the type of highway improvement specified for a study section. Structures were estimated based on the square feet of deficient structures on the sections, and multiplied by a unit cost per square foot of structure (according to the type of structure) to arrive at a total structure cost for the study section.

VI. MASS ANALYSIS PROCEDURES FOR LOCAL ROADS AND STREETS

A. Mass Analysis Procedures—General

The method of appraising needs for local roads and streets specified by the Federal Highway Administration was developed in recognition that these facilities comprise a large portion of the total highway mileage (roughly 70 percent) and consist of relatively low cost facilities. Because of these characteristics, the average annual cost concept of estimating needs was used.

The average annual cost approach assumes that the needs requirements for local roads and streets is a continuing replacement process. Statistical data developed from road life and investment studies are translated into average annual costs to: (1) reconstruct deficient (or construct new) facilities and retain them in service; and (2) retain in service facilities which are presently adequate.

Factors for determining the annual cost to reconstruct and retain deficient facilities, to retain adequate facilities, and to retain new facilities were provided by the Federal Highway Administration. These factors were derived from the survivor curves presented in the text of *Economic Analysis for Highways* by Robley Winfrey. From these survivor curves, the facilities that became deficient at a given age can be estimated and the costs to keep these facilities in service can be applied. The following assumptions were used in computing the factors:

1. No interest rate is applied.
2. Presently adequate facilities are at one-half of their investment life.
3. Back-log needs (presently deficient facilities) are taken care of in the first four years.
4. The initial cost of urban facilities was assumed to be borne by the land developer.

The factors that were derived were applied to the initial construction cost per mile for each design type to arrive at an annual average cost per mile.

B. Urban Local Streets

(1) Stratification of Mileage

The first step in analyzing local street mileage was to stratify the existing and proposed mileage into design types so that applicable design standards could be applied in a consistent manner. The stratification was done by taking a random field sample of the local street mileage. The sample consisted of five percent or more of the 1990 mileage in each urbanized area and each small urban area category. Existing industrial and commercial mileage was measured from the Urban-In-Fact Area Land Use Maps, and the distribu-

tion of mileage in the industrial and commercial areas determined from the sampled mileage was applied to the total measured (existing) industrial and commercial mileage. Residential mileage was determined by subtracting the industrial and commercial mileage from the total local street mileage in each urban area, and the distribution of mileage in the residential areas determined from the sampled mileage was applied to the total existing residential mileage.

(2) Appraisal of Present Adequacy

After the mileage had been stratified into design types, the number of miles that were presently intolerable was determined. Minimum tolerable conditions provided by the Federal Highway Administration aided in determining the streets that were intolerable. In addition to the minimum tolerable conditions, a street could be rated as intolerable if the pavement condition was so poor that it could not be corrected through routine maintenance.

(3) Development of Construction Costs

Initial construction costs were to be estimated for each design type so that the factors for determining annual costs could be applied to arrive at an annual average cost per mile. These costs are categorized into: (1) base and surfacing; and (2) grade and drain. Base and surfacing costs for the local streets were estimated for each design standard at the same time as the base and surfacing costs of the classified systems. Grade and drain costs were estimated on a per-foot width of street basis from S.I.D. bid tabulations from several cities. These per-foot of width costs were applied to the widths of the appropriate urban design standards to arrive at a grading and drainage cost per mile for each design standard.

Costs for rights-of-way are not included because it is assumed that they have an indefinite economic life on existing facilities, and on new facilities they would be supplied by the abutting landowners or land developers. Costs for urban street structures are omitted because they are so few that they would have negligible effect on the total cost.

(4) Determining Average Annual Costs Per Mile

The initial construction costs computed in step 3 were multiplied by the appropriate cost factors to arrive at an annual average cost per mile to either reconstruct intolerable (or construct new) facilities and retain them in service, or retain in service presently tolerable facilities for each urban local street design type.

(5) Determining Total Average Annual Costs

The last step in the needs appraisal for local streets was the determination of the total annual average cost for each design type. This entailed multiplying the mileage in each design type by the corresponding annual average costs per mile. Mass Analysis Schedules MA–9 through MA–12 were provided by the Federal Highway Administration for these calculations.

Mass Analysis Schedules MA–9 through MA–12 also provided for the inclusion of maintenance and administration costs, which were obtained from the *Maintenance Schedule* and the *Administration Schedule* described in detail under that section in this report.

The total average annual costs for each urbanized area and each small urban area category were recorded on Mass Analysis Schedules MA–9 through MA–12. These schedules are shown in Appendix 'C'.

C. Rural Local Roads

(1) Stratification of Mileage

Stratification of local road mileage into design types was done by taking an office inventory sample of six randomly sampled counties (see sampling procedures and rates for the selection of the counties). The sample consisted of five percent or more of the 1990 mileage in each of the six rural sample areas.

Stratification of the local road mileage also required that the mileage be broken down by cost area and terrain type, and the mass analysis forms provided by the Federal Highway Administration are arranged to accept only one terrain type in a cost area. However, the cost areas were set up so that variations in terrain did not constitute a new cost area, but were analyzed as flat, rolling, or mountainous construction within a cost area. Therefore, it was necessary to prorate the local road mileage in each cost area to each terrain type. The method used was to examine the topography of each county, and estimate the mileage of local roads in each terrain type. Since there were two cost areas this breakdown gave effectively six categories of local roads: (1) Cost Area 1–Flat; (2) Cost Area 1–Rolling; (3) Cost Area 1–Mountainous; (4) Cost Area 2–Flat; (5) Cost Area 2–Rolling; and (6) Cost Area 2–Mountainous.

The stratification of the total local road mileage was done by expanding the sampled mileage (broken down by design type) to the total local road mileage in each cost area. This mileage was then prorated to flat, rolling, and mountainous terrain types according to the miles in each terrain type in each cost area.

(2) Appraisal of Present Adequacy

After the mileage had been stratified into design and terrain types, the number of miles which were presently intolerable was determined. Minimum tolerable conditions provided by the Federal Highway Administration aided in determining the roads that were intolerable. In addition to the minimum tolerable conditions, a road could be rated as intolerable if the pavement condition was so poor that it could not be corrected through routine maintenance.

(3) Development of Construction Costs

Initial construction costs were estimated for each design type so that the annual cost factors could be applied to arrive at an annual average cost per mile. These costs are categorized into: (1) base and surfacing; (2) grade and drain; and (3) structure costs. Base and surfacing costs for the local roads were estimated for each design standard at the same time as the base and surfacing costs of the classified systems. Grade and drain costs were estimated from historical costs of comparable highways on the secondary system. Unit costs for structures were obtained from the State Highway Commission's Bridge Division.

Costs for rights-of-way are not included because it is assumed that they have an indefinite economic life on existing facilities, and on new facilities would be supplied by the abutting landowners or land developers.

(4) Determining Average Annual Costs Per Mile

The initial construction costs determined in step 3 were multiplied by the appropriate annual cost factors to arrive at an annual average cost per mile to either reconstruct intolerable (or construct new) facilities and retain them in service, or retain in service presently tolerable facilities, for each rural local road design type.

(5) Structures

There is a discrepancy in the handling of bridge structures in the rural local roads mass analysis procedure prescribed by the Federal Highway Administration. This discrepancy arises because there is no relation of the tolerability or intolerability of a structure to the road on which the structure occurs. In many cases in the field sample, roads were found intolerable with bridges that were tolerable, and visa-versa. However, on the mass analysis forms, there are no provisions made for the independent analysis of bridges. Instead the bridges, both tolerable and intolerable, are tied to the tolerability of the road. The information as to the tolerability of the bridges can not be used in the analysis.

The approach to this situation was to determine the feet of bridge structure per

mile of local road for each local road design type. The square feet of bridge structure per mile of local road was then determined according to the width of bridge required in the design standards. Then appropriate unit costs were applied to this bridge area to arrive at an initial construction cost per mile of local road for the bridge structures for each local road design type. This initial construction cost was multiplied by the appropriate annual cost factor to arrive at an average annual cost per mile to either reconstruct intolerable (or construct new) facilities and retain them in service, or retain in service presently tolerable facilities for each design type.

This procedure does not allow the independent analysis of tolerable and intolerable bridges, but relates the bridges to the tolerability of the road on which it occurs.

The difference in bridge costs which result from analyzing the bridges independently as compared to analyzing the bridges as an integral part of the local roads is shown in the following table.

RURAL LOCAL ROAD BRIDGE COST COMPARISON

	Independent Bridge Analysis ($1,000)	Bridges Related to Road Tolerability ($1,000)
Cost Area No. 1		
Tolerable Bridges	$ 74	$ 67
Intolerable Bridges	605	673
Total	$ 679	$ 740
Cost Area No. 2		
Tolerable Bridges	$ 113	$ 262
Intolerable Bridges	1,401	869
Total	$1,514	$1,131
TOTAL BOTH COST AREAS	$2,193	$1,871

(6) Determining Total Average Annual Costs

The last step in the needs appraisal for local roads and streets was the determination of the total annual average cost for each design type. This entailed multiplying the mileage in each design type by the corresponding annual average costs per mile. Mass Analysis Schedule MA–8 was provided by the Federal Highway Administration for these calculations.

This schedule includes maintenance and administration costs, which were obtained from the *Maintenance Schedule* and the *Administration Schedule* described in detail under that section in this report.

The total average annual costs for each cost area and terrain type were recorded on six Mass Analysis MA–8 Schedules. These schedules are shown in Appendix 'C'.

VII. MAINTENANCE ESTIMATES

To provide a complete picture of the cost of highway needs, it is necessary to include the costs of maintenance and administration. Excluding interstate, maintenance estimates are made on a per-mile basis for each roadway and surface type of each functional system. For the interstate system, maintenance is reported in total for the twenty-year period, 1970 to 1990, by rural area, the small urban area categories, and each urbanized area.

A. Description of Maintenance

Maintenance in Montana is a very significant portion of highway needs. Because of the extreme winter season in Montana, a considerable part of the maintenance budgets is spent for snow removal, snow fences, sanding, and chemical treatment of ice. In addition, numerous freeze-thaw cycles and frost heaves subject the roadway to a harsh environment in which to survive, and require considerable expenditures for pavement patching and sealing. The interstate system, in particular, will pose a challenging maintenance problem for the State in the future.

B. Development of Maintenance Estimates

The criteria for maintenance estimates is that maintenance estimates will include all physical maintenance and traffic services as described in the AASHO Manual; *Uniform Highway Accounting Procedures*. Betterments (minor replacement construction) are excluded from the maintenance estimates.

The development of maintenance costs are complicated by the requirement of the Federal Highway Administration that:

> *'Cost estimates should assume* **adequate levels of maintenance expenditures** *at 1969 prices as distinguished from actual expenditures which may reflect arbitrary budget restrictions.'*

It is difficult to apply an exact definition to the term 'adequate level of maintenance', because the term itself, without being qualified, is not exact. To take an example, it could mean to keep the road just passable to traffic under normal conditions, or, it could mean keeping the roadway and appurtenances in like-new condition at all times. The assumption is made, for the purposes of this Study, that existing budget restrictions do not permit maintenance levels to rise to a level that would be considered 'adequate'. Therefore, the following factors, which are considered to be reasonable and consistent, were applied to the actual maintenance expenditures to approximate an 'adequate' level of maintenance.

SYSTEM	FACTOR
Rural	
Federal-aid Primary	1.10
Federal-aid Secondary	1.20
Non-Federal-aid	1.30
Urban	
All Systems	1.20
Interstate	
Urban and Rural	1.20

C. Systems Other Than Interstate

The development of actual maintenance expenditures per mile for the **rural** systems consisted of analyzing state and county maintenance records, and determining a per-mile maintenance cost for federal-aid primary, federal-aid secondary, and non-federal-aid systems substratified by pavement type. These figures were adjusted by applying the appropriate factor to arrive at an 'adequate' level of maintenance. The adjusted figures were then prorated through the classified systems according to the proportions of roads in each category of jurisdictional responsibility of each system.

The per-mile maintenance costs for the **urban** systems consisted of analyzing state and city maintenance records, and again determining a per-mile maintenance cost for the roads in each category of jurisdictional responsibility. These costs were adjusted to yield an 'adequate' level of maintenance, and prorated according to the mix of jurisdictional responsibilities in each classification to arrive at the required per-mile maintenance costs.

The final per-mile maintenance costs for the urban and rural classified systems, excluding interstate, are shown in the Maintenance Schedule, Figure No. 7.

D. Interstate System

For the interstate system, the maintenance costs to be determined are the total maintenance costs for the twenty-year period, 1970 to 1990, reported by rural, each urbanized area, and the three small urban area groups. Since the oldest section of four-lane interstate in Montana is about 12 years old, it was not feasible to use existing historical maintenance records without adjustment.

Since the interstate is programed to receive an overlay at 13-year intervals, the decision was made to set the maintenance age of the interstate on a 13-year recurrence interval. This approach makes the assumption that the interstate maintenance cost per year after an overlay will revert back to

the maintenance cost per year of a new interstate. Since no interstate has yet had an overlay on this program, this assumption can not be validated. However, it seems a reasonable assumption to make.

Maintenance expenditures per mile were then developed for four-lane interstate with ages of 1–3 years, 4–6 years, and 7 years and over. These costs were applied to the corresponding miles of interstate that fell in each of the three maintenance age categories, the adjustment factor to provide an 'adequate' level of maintenance applied, and a total cost for the maintenance of the four-lane interstate for the twenty-year period was calculated.

The two-lane interstate is scheduled to be upgraded to four-lane interstate by 1976. Therefore, an average cost per mile, regardless of age, was developed based upon past expenditures for existing two-lane interstate. This cost per mile was adjusted to provide for an 'adequate' level of maintenance, and the total amount estimated for maintenance of two-lane interstate for the period the two-lane interstate is in service. (Maintenance for four-lane interstate is estimated when the two-lane interstate is upgraded to four-lane.)

An analysis showed that expenditures for maintenance items generally associated with urban areas, such as lighting, beautification, and additional ramp mileage, could be prorated into the urban interstate on a per-mile basis. The per-mile cost for these expenditures, after adjustment to provide for an 'adequate' level of maintenance, was added to the average per-mile maintenance cost for the interstate to arrive at an urban interstate maintenance estimate per mile. This unit maintenance expenditure was multiplied by the number of mile–years of maintenance that would be needed for each urbanized area and small urban area group to arrive at the urban maintenance estimates.

The rural interstate maintenance estimate was then determined by subtracting the total of the urban maintenance estimates from the estimate for the total interstate system.

The maintenance estimates for the interstate system are shown on the Maintenance and Administration Schedule for the Interstate System, Figure No. 9.

Figure No. 7

MAINTENANCE SCHEDULE

Average annual per-mile maintenance cost estimate

State Montana

Roadway and Surface Types 1/, 2/ & 3/	Rural Study Systems			
	Principal Arterials	Minor Arterials	Collectors	Locals
6 or more lanes - fwy				
4 lanes - fwy				
Other multilane	2,323	2,051	1,252	
2 lanes 1/	1,486	1,312	801	707
2 lanes 2/	1,486	1,312	801	707
2 lanes 3/	1,486	1,312	801	707
Gravel & graded & drained			449	374

Roadway and Surface Types 1/, 2/ & 3/	Urban Study Systems				
	Freeways and Expressways	Other Principal Arterials	Minor Arterial Streets	Collector Streets	Local Streets
6 or more lanes - fwy					
4 lanes - fwy & exp					
Other multilane		5,581	5,059	4,562	4,537
2 lanes 1/		3,583	3,081	2,926	2,910
2 lanes 2/		3,583	3,081	2,926	2,910
2 lanes 3/		3,583	3,081	2,926	2,910

1/ High Type
2/ Intermediate Type
3/ Low Type. For surface type definitions see Table III-14.

Not Applicable

VIII. ADMINISTRATION COSTS

A. Sources of Information

It was found that records of costs for the administration of highways needed for the administration costs requested by the Federal Highway Administration were difficult to come by in the State of Montana. The State Highway Commission does not keep separate records of administration for each federal aid system, and the cities and counties do not keep the administration of highways separate from other administration costs. Therefore, a considerable amount of judgment was needed in order to develop reasonable administration costs for the functional system.

B. Administration of Federal-aid Systems

Records of the administration of state-operated highways were available from the State Highway Commission's Accounting Division, as well as expenditures for maintenance, engineering, right-of-way, and construction. Therefore, the determination of a percentage rate of administration for all state-operated highways was easily done. However, no records were kept on a system basis, and it was found that the administration of each system could not be determined independently. The decision was made to use a constant percentage for the administration of all state-operated highways.

C. Administration of Urban Local Streets

General administration costs for cities were available from the most recent city budgets. However, the amount of administration expenditures spent for the administration of highways was not separated from the rest of the administration costs, and it was necessary to estimate the portion spent on highways. This was done by interviewing officials in several cities, and estimating the amount of time each administration employee spent on the administration of highways. In this manner, the direct labor cost for administration was estimated. An overhead factor was applied to this direct labor figure for the total administration cost. The total administration cost was divided by the maintenance and capital outlay expenditures for the administration percentage. This procedure was done for each urbanized area and for several cities in each small urban area group.

D. Administration of Rural Local Roads

As with the cities, the counties did not have their administration costs broken out by highways. The amount of administration spent on highways was estimated in the same manner as for cities and the percentage of administration also was determined in the same manner as for the cities.

E. Use of Administration Percentages on Functional Systems

Since the functionally classified system of highways does not correspond with the federal-

aid and off-system highways, it was necessary to adjust the derived administration figures to the functional systems. The percentage of administration determined for the state-operated system of highways was considered directly applicable to the interstate and principal arterial systems, both urban and rural. The administration percentages determined for the urban local streets and rural local roads were considered applicable to their corresponding highways on the functional system. For those functional systems which fell between the rural principal arterials and the local roads and streets, the administration costs were prorated. With this method, all of the required percentages needed were calculated. The percentages are shown in the Administration Schedule, Figure No. 8.

F. Interstate System

Administration for the interstate system was requested by lump sum amounts for the interstate in rural areas, each urbanized area, and each small urban area group for the twenty-year period 1970–1990. The total maintenance and capital outlay expended in each of the above categories was estimated from the 1970 Interstate Cost Estimate, the worksheets on the interstate system, and the previousiy calculated maintenance costs for the interstate system. Then the administration percentage derived for state-operated highways was applied to these expenditures, and the total administration cost for the twenty-year period for each category was calculated. This procedure provided the figures to complete the administration portion of the Maintenance and Administration Schedule for the Interstate System shown in Figure No. 9.

Figure No. 8

ADMINISTRATION SCHEDULE

Percentage factors for estimating costs of administration

State Montana

Rural Systems	Percentage Factor
Principal Arterial	6.75
Minor Arterial	7.83
Collector	8.92
Local	10.00

Urban Systems	Percentage Factor			
	Urbanized	5,000-9,999	10,000-24,999	25,000-49,999
Freeways and Expressways				
Other Principal Arterials	6.75	6.75	6.75	6.75
Minor Arterial Streets	7.67	5.55	6.88	7.08
Collector Streets	8.59	4.35	7.02	7.40
Local Streets	9.51	3.15	7.15	7.73

Figure No. 9

MAINTENANCE AND ADMINISTRATION SCHEDULE FOR THE INTERSTATE SYSTEM

State Montana

Sheet 1 of 1

TYPE OF DEVELOPMENT		MAINTENANCE TOTAL COST ($1,000)	ADMINISTRATION TOTAL COST ($1,000)
RURAL		56,986	33,285
SMALL URBAN AREAS:			
1990 POPULATION	5,000-9,999	581	50
	10,000-24,999	0	0
	25,000-49,999	3,001	310
URBANIZED AREA:			
NAME	CODE		
Billings	121	1,727	188
Great Falls	122	854	76
Missoula	410	1,008	82

IX. SUMMARY OF NEEDS AND IMPROVEMENT ANALYSIS

The following tables summarize the results of the Needs and Improvement Analysis. The costs shown include construction, engineering, maintenance, and administration costs.

On those study sections in the analysis that required two improvements in the twenty-year period, 1970–1990, only the costs for the initial improvement is included in this summary. The second generation improvements falling in the twenty-year period, as well as stop-gap improvements (improvements required to keep an intolerable facility useable until it can be improved) will be estimated by the Federal Highway Administration at their Washington, D. C. office.

The needs for the local roads and streets are taken from the Mass Analysis Forms (Appendix 'C') and include the **total** needs for the twenty-year period. These needs reported are the costs of the improvements on a facility amortized over the average life of the improvement (average annual cost) times the number of years in the twenty-year period the facility is in service (twenty years for existing facilities and an average of ten years for new facilities). It should be noted that the costs reported are for the standards and criteria as set forth by the Federal Highway Administration for this Study, and are not necessarily compatible with the types of local roads and streets most prevalent in the State of Montana.

The costs for local roads and streets are shown separately in the following tables because the analysis for local roads and streets is not comparable to the analysis for the other functional systems.

URBAN FUNCTIONAL SYSTEMS

Functional Classification	1990 Miles	Deficient Miles	Administration Needs ($1,000)	Maintenance Needs ($1,000)	Construction Needs ($1,000)	Total Needs ($1,000)
Billings						
Interstate(1)	12	12	0	0	$ 666	$ 666
Other Principal Arterials	48	45	$ 1,532	$ 4,424	18,275	24,231
Minor Arterials	53	51	1,728	3,673	18,841	24,242
Collectors	64	64	1,990	3,242	19,976	25,208
Sub-total			$ 5,250	$ 11,339	$ 57,758	$ 74,347
Local Streets	442	442	$ 5,490	$ 19,580	$ 37,950	$ 63,020
Great Falls						
Interstate(1)	6	2	0	0	$ 80	$ 80
Other Principal Arterials	31	31	$ 1,047	$ 2,991	12,570	16,608
Minor Arterials	42	41	1,850	2,853	21,273	25,976
Collectors	33	33	1,087	1,936	10,714	13,737
Sub-total			$ 3,984	$ 7,780	$ 44,637	$ 56,401
Local Streets	303	303	$ 4,730	$ 14,780	$ 35,130	$ 54,640
Missoula						
Interstate(1)	7	0	0	0	0	0
Other Principal Arterials	20	17	$ 652	$ 1,949	$ 7,674	$ 10,275
Minor Arterials	44	43	1,948	2,921	22,583	27,452
Collectors	42	42	1,600	2,455	16,199	20,254
Sub-total			$ 4,200	$ 7,325	$ 46,456	$ 57,981
Local Streets	353	353	$ 4,790	$ 15,310	$ 35,010	$ 55,110

(1) See Page 59

URBAN FUNCTIONAL SYSTEMS
(Cont.)

Functional Classification	1990 Miles	Deficient Miles	Administration Needs ($1,000)	Maintenance Needs ($1,000)	Construction Needs ($1,000)	Total Needs ($1,000)
Small Urban – 25,000-49,999						
Interstate(1)	22	11	0	0	$ 597	$ 597
Other Principal Arterials	48	45	$ 1,449	$ 4,086	17,427	22,962
Minor Arterials	65	58	1,904	3,727	23,185	28,816
Collectors	78	78	1,329	4,577	13,500	19,406
Sub-total			$ 4,682	$ 12,390	$ 54,709	$ 71,781
Local Streets	605	605	$ 7,090	$ 27,790	$ 64,530	$ 99,410
Small Urban – 10,000-24,999						
Interstate(1)	0	0	0	0	0	0
Other Principal Arterials	19	19	$ 677	$ 1,673	$ 8,562	$ 10,912
Minor Arterials	14	14	284	851	3,294	4,429
Collectors	18	18	399	1,057	4,670	6,126
Sub-total			$ 1,360	$ 3,581	$ 16,526	$ 21,467
Local Streets	127	127	$ 2,040	$ 7,010	$ 21,420	$ 30,470
Small Urban – 5,000-9,999						
Interstate(1)	2	2	0	0	$ 112	$ 112
Other Principal Arterials	38	34	$ 1,063	$ 3,267	12,589	16,919
Minor Arterials	30	25	364	1,872	4,669	6,905
Collectors	41	41	530	2,449	9,717	12,696
Sub-total			$ 1,957	$ 7,588	$ 27,087	$ 36,632
Local Streets	252	252	$ 1,630	$ 13,690	$ 38,260	$ 53,580

(1) Does not include those costs reported in the 1970 Interstate Cost Estimate, or maintenance and administration for the Interstate System.

NEEDS SUMMARY TABLE

Functional Classification	1990 Miles	Deficient Miles	Administration Needs ($1,000)	Maintenance Needs ($1,000)	Construction Needs ($1,000)	Total Needs ($1,000)
Total Urban Functional System Needs						
Interstate	49	27	0	0	$ 1,455	$ 1,455
Other Principal Arterials...	204	191	$ 6,420	$ 18,390	77,097	101,907
Minor Arterials	248	232	8,078	15,897	93,845	117,820
Collectors	276	276	6,935	15,716	74,776	97,427
Total Classified Urban Highways	777	726	$ 21,433	$ 50,003	$ 247,173	$ 318,609
Local Streets	2,082	2,082	$ 25,770	$ 98,160	$ 232,300	$ 356,230
Total Rural Functional System Needs						
Interstate	1,140	558	0	0	$ 30,383	$ 30,383
Other Principal Arterials...	1,991	1,907	$ 32,724	$ 63,480	421,562	517,766
Minor Arterials	3,742	3,119	38,700	99,581	394,398	532,679
Major Collectors	5,249	4,629	38,160	76,444	350,871	465,475
Minor Collectors	11,023	8,213	76,202	140,093	714,451	930,746
Total Classified Rural Highways	23,145	18,426	$ 185,786	$ 379,598	$1,911,665	$2,477,049
Local Roads	43,847	43,847	$ 450,070	$ 608,770	$3,891,420	$4,950,260

The costs for the urban and rural classified systems only include the costs for the first deficiency occurring in the twenty-year period. Costs for the remaining deficiencies (second-generation costs), costs reported in the 1970 Interstate Cost Estimate, and maintenance and administration costs for the interstate system are not included.

The costs for the urban local streets and rural local roads include the total needs for the twenty-year period.

In general, the standards specified for the classified systems by the Federal Highway Administration for this Study are somewhat lower than the standards currently in use by the State of Montana. The design standards used for local roads and streets specified by the Federal Highway Administration are somewhat higher than those currently in use. The costs reflect these differences in the design standards.

X. CONCLUSIONS OF THE NATIONAL HIGHWAY FUNCTIONAL CLASSIFICATION AND NEEDS STUDY

The opinion of the authors is that this Study Report will have far-reaching effects. This Report is an investigation into functionally classifying highways in the State of Montana, and is probably the first step in enacting a new method of appropriating federal-aid funds to highways. The 1970 Federal-aid Highway Act states that:

> *'The Secretary of Transportation shall develop and include in the report to Congress required to be submitted in January, 1972, specific recommendations for the functional realignment of the federal-aid systems.'*

Congress has currently approved federal-aid to highways based on existing federal-aid systems to 1974. At that time, existing federal-aid systems may be replaced by the functionally classified systems described in this Report.

This Report is the third of a series of biennial reports on the future highway needs of the Nation. These reports will provide a continuous review of all highways in Montana and the Nation, and will insure that new transportation policies and objectives will be incorporated into the highway systems soon after they are formulated. It, therefore, is recommended that those individuals and organizations interested in the highways of the State be familiar with the terminology and content of this Report.

At this point, it is advisable to reiterate that the costs presented in this Report are for standards specified by the Federal Highway Administration specifically for this Nation-wide Study, and are not necessarily compatible with the types of construction currently being used in Montana. This is done so that needs on a Nation-wide basis can be compared and a consistent funding program can be recommended to Congress In particular, the standards for the local roads and streets are higher than those in common use in Montana, resulting in higher costs than what would normally be estimated. It is also emphasized that this is a **needs** study that estimates the cost to bring the existing highway systems to a predetermined standard as opposed to a **capital improvement program** that identifies specific improvements to be constructed within available funding levels. The authors do not feel that it is feasible to fund all of the needs of this Study. Priorities will, therefore, have to be set so that the maximum return for the dollars spent can be realized.

APPENDIX A

APPENDIX 'A'

DATA SUBMITTAL REQUIREMENTS

Figure No. 10 ..... 1990 State-wide Area, Population, Mileage, and Travel Summary

Figure No. 11 ..... 1990 Rural Data Summary

Figure No. 12 ..... 1990 Rural Supplemental Data Summary

Figure No. 13 ..... 1990 Individual Urbanized Area Data Summary – Billings

Figure No. 14 ..... 1990 Individual Urbanized Area Data Summary – Great Falls

Figure No. 15 ..... 1990 Individual Urbanized Area Data Summary – Missoula

Figure No. 16 ..... 1990 Small Urban Area Data Summary – 25,000 to 49,999 Population

Figure No. 17 ..... 1990 Small Urban Area Data Summary – 10,000 to 24,999 Population

Figure No. 18 ..... 1990 Small Urban Area Data Summary – 5,000 to 9,999 Population

Figure No. 19 ..... 1990 Urban Connecting Link Summary

Figure No. 20 ..... 1990 State-wide Route Log

Map No. 1 ..... Montana 1990 Arterial Systems Map

Map No. 2 ..... Great Falls Urbanized Area Systems Map

Map No. 3 ..... Small Urban Area 25,000–49,999 Systems Map

Map No. 4 ..... Small Urban Area 10,000–24,999 Systems Map

Map No. 5 ..... Small Urban Area 5,000–9,999 Systems Map

Map No. 6 ..... Hill County 1990 Highway Functional Classification Map

Map No. 7 ..... Lincoln County 1990 Highway Functional Classification Map

Map No. 8 ..... Missoula County 1990 Highway Functional Classification Map

Map No. 9 ..... Wheatland County 1990 Highway Functional Classification Map

Figure No. 10

1990

STATEWIDE AREA, POPULATION, MILEAGE, AND TRAVEL SUMMARY

I. State name Montana

State code: 24 (1–2)

9 (3)

II. 1990 Land area (square miles)

State total: 145736 (4–9)

Rural: 145491 (11–16)

Urban: 245 (18–22)

III. 1990 population (thousands)

State total: 860 (23–28)

Rural: 351 (30–34)

Urban: 509 (36–41)

IV. 1990 street and highway mileage

State total: 69850 (43–48)

V. 1990 daily vehicle miles of travel (thousands)

State total: 19172 (50–57)

VI Card identification code: 99 (79–80)

Figure No. 11

1990

RURAL DATA SUMMARY

MONTANA

Card Number	Functional Classification	Total						Federal aid primary		Federal-aid secondary		Non federal-aid			State Code
		Mileage			Travel										
		Miles	% of rural total	Cumulative % of rural total	Daily vehicle miles of travel (thousands)	% of rural total	Cumulative % of rural total	Miles	Daily vehicle miles of travel (thousands)	Miles	Daily vehicle miles of travel (thousands)	Miles	Daily vehicle miles of travel (thousands)		
1 2		3 4 5 6 7 8 9			12 13 14 15 16 17 18 19			22 23 24 25 26	29 30 31 32 33 34 35 36	39 40 41 42 43	46 47 48 49 50 51 52 53	56 57 58 59 60 61	64 65 66 67 68 69 70 71		79 80
	Principal arterial system														
0 1	Interstate	9 1136	1.7	1.7	5470	36.4	36.4	1136	5470	0 0 0 0 0	0 0 0 0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0 0 0 0		2 4
0 2	Other principal arterials	9 1991	3.0	4.7	3615	24.0	60.4	1957	3580	32	28	2	7		2 4
0 3	Minor arterial road system	9 3742	5.6	10.3	2774	18.4	78.8	2538	2226	1120	491	84	57		2 4
	Collector road system														
0 4	Major collectors	9 5249	7.8	18.1	1135	7.5	86.3	289	190	3171	691	1789	254		2 4
0 5	Minor collectors	9 11023	16.5	34.6	955	6.4	92.7	230	61	1368	217	9425	677		2 4
0 6	Local road system	9 43847	65.4	100.0	1091	7.3	100.0	0	0	33	13	43814	1078		2 4
0 7	Total	9 66988	100.0	–	15040	100.0	–	6150	11527	5724	1440	55114	2073		2 4

Figure No. 12

1990

RURAL SUPPLEMENTAL DATA SUMMARY

SHEET 1 OF 3

| Card Number | | | Rural Land Area (Square Miles) 1968 | | | | | Rural Land Area (Square Miles) 1990 | | | | | Total 1968 Vehicle Registrations | | | | Population 1968 Total | | | | Population 1968 % Rural x x.x | | | | Population 1990 Total | | | | Population 1990 % Rural x x.x | | | | 1968 Rural Functional Mileage (1968 Functional Classification)1/ Principal Arterial System Interstate | | | | | Principal Arterial System Other Principal Arterials | | | | Minor Arterial Road System | | | | | Collector Road System | | | | | Local Road System | | | | | | Cost Area Code | | | County Code2/ | | | State Code | |
|---|---|---

Figure No.12 (Cont.)

1990

RURAL SUPPLEMENTAL DATA SUMMARY

SHEET 2 OF 3

| Card Number | | | Rural Land Area (Square Miles) | | Total 1968 Vehicle Registrations | Population | | | | 1968 Rural Functional Mileage (1968 Functional Classification)1/ | | | |

Figure No. 12 (Cont.)

1990

RURAL SUPPLEMENTAL DATA SUMMARY

SHEET 3 OF 3

Card Number	Rural Land Area (Square Miles) 1968	Rural Land Area (Square Miles) 1990	Total 1968 Vehicle Registrations	Population 1968 Total	Population 1968 % Rural x x.x	Population 1990 Total	Population 1990 % Rural x x.x	1968 Rural Functional Mileage (1968 Functional Classification)1/ Principal Arterial System: Interstate	Principal Arterial System: Other Principal Arterials	Minor Arterial Road System	Collector Road System	Local Road System	Cost Area Code	County Code2/	State Code
1 2 3	4 5 6 7 8 9	10 11 12 13 14 15	16 17 18 19 20	21 22 23 24 25 26	27 28 29	30 31 32 33 34 35	36 37 38	39 40 41 42 43 44	45 46 47 48 49 50	51 52 53 54 55 56	57 58 59 60 61 62	63 64 65 66 67 68	69 70 71 72 73 74 75	76 77 78	79 80
099	2799	2799	4998	7999		7999		0	0	178	305	1134	1	454	24
099	1700	1700	5865	6999		6999		0	0	94	303	832	2	464	24
099	702	690	245546	461250		471249		25	27	16	48	283	1	474	24
099	1797	1797	41126	5999		5999		13	26	22	249	690	2	484	24
099	1846	1846	27755	3999		3999		14	23	28	241	325	2	494	24
099	2294	2294	6499	6999		6999		15	7	70	356	1007	2	502	24
099	1950	1950	5372	7999		6999		26	61	0	368	909	2	512	24
099	984	984	10911	1999		1999		26	0	0	139	233	2	522	24
099	4959	4957	103311	226188		115513		0	78	106	350	1338	2	532	24
099	1422	1422	2163	3999		3999		0	0	80	134	320	2	542	24
099	889	889	16369	2999		1999		15	0	26	135	371	2	552	24
099	2606	2578	566944	821613		122075		46	73	40	335	1237	2	562	24
099															
099															
099															
099															
099															
099															
099															
099															
099															
1 2 3	4 5 6 7 8 9	10 11 12 13 14 15	16 17 18 19 20	21 22 23 24 25 26	27 28 29	30 31 32 33 34 35	36 37 38	39 40 41 42 43 44	45 46 47 48 49 50	51 52 53 54 55 56	57 58 59 60 61 62	63 64 65 66 67 68	69 70 71 72 73 74 75	76 77 78	79 80

1/ This portion of this form is to be completed only for the rural portions of tha counties sampled in the needs estimating phase of the study.

2/ It is recognized that not all states are subdivided into counties. In some States the subdivisions are parishes and election districts. The geographical areas (and codes) referred to as counties in the IBM coding manual are those intended for use in this study.

NOTE Rural land area does not include 269 sq. mi. under Federal domain in Yellowstone National Park as reported by the Census of Population.

Figure No. 13

1990
INDIVIDUAL URBANIZED AREA DATA SUMMARY

Card Number	Urban Functional Classification	Total						Federal-aid primary		Federal-aid secondary		Non-federal-aid		Urbanized Area Code	State Code
		Mileage			Travel										
		Miles	% of Total	Cumulative % of Total	Daily vehicle miles of travel (thousands)	% of Total	Cumulative % of Total	Miles	Daily vehicle miles of travel (thousands)	Miles	Daily vehicle miles of travel (thousands)	Miles	Daily vehicle miles of travel (thousands)		
1 2		3 4 5 6 7 8 9			12 13 14 15 16 17 18 19			22 23 24 25 26	29 30 31 32 33 34 35 36	39 40 41 42 43	46 47 48 49 50 51 52 53	56 57 58 59 60 61	64 65 66 67 68 69 70 71	76 77 78	79 80
	Principal arterial system														
4 1	Interstate	9 13	2.1	2.1	159	15.8	15.8	13	159	0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0	0 0 3 0 0 0 0 0	121	24
4 2	Other freeways and expressways	9 0	0	2.1	0	0	15.8	0	0	0	0	0	0	121	24
4 3	Other principal arterials	9 48	7.7	9.8	396	39.2	55.0	20	198	18	144	10	54	121	24
4 4	Minor arterial street system	9 53	8.6	18.4	208	20.6	75.6	6	57	6	49	41	102	121	24
4 5	Collector street system	9 64	10.3	28.7	83	8.2	83.8	0	0	0	0	64	83	121	24
4 6	Local street system	9 442	71.3	100.0	163	16.2	100.0	0	0	0	0	442	163	121	24
4 7	Total	9 620	100.0	-	1009	100.0	-	39	414	24	193	557	402	121	24

State Name: Montana

Urbanized Area Name: Billings

Figure No. 14

1990
INDIVIDUAL URBANIZED AREA DATA SUMMARY

Card Number	Urban Functional Classification	Total						Federal-aid primary		Federal-aid secondary		Non-federal-aid		Urbanized Area Code	State Code
		Mileage			Travel										
		Miles	% of Total	Cumulative % of Total	Daily vehicle miles of travel (thousands)	% of Total	Cumulative % of Total	Miles	Daily vehicle miles of travel (thousands)	Miles	Daily vehicle miles of travel (thousands)	Miles	Daily vehicle miles of travel (thousands		
1 2		3 4 5 6 7 8 9			12 13 14 15 16 17 18 19			22 23 24 25 26	29 30 31 32 33 34 35 36	39 40 41 42 43	46 47 48 49 50 51 52 53	56 57 58 59 60 61	64 65 66 67 68 69 70 71	76 77 78	79 80
	Principal arterial system														
4 1	Interstate	9 6	1.4	1.4	9 0	9.5	9.5	6	9 0	0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0 0 0	1 2 2	2 4
4 2	Other freeways and expressways	9 0	0	1.4	0	0	9.5	0	0	0	0	0	0	1 2 2	2 4
4 3	Other principal arterials	9 3 1	7.5	8.9	3 9 1	41.4	50.9	2 5	3 2 1	0	0	6	7 0	1 2 2	2 4
4 4	Minor arterial street system	9 4 2	10.1	19.0	2 1 7	23.0	73.9	5	2 2	1 0	5 0	2 7	1 4 5	1 2 2	2 4
4 5	Collector street system	9 3 3	8.0	27.0	8 9	9.4	83.3	0	0	1	3	3 2	8 6	1 2 2	2 4
4 6	Local street system	9 3 0 3	73.0	100.0	1 5 7	16.7	100.0	0	0	0	0	3 0 3	1 5 7	1 2 2	2 4
4 7	Total	9 4 1 5	100.0	–	9 4 4	100.0	–	3 6	4 3 3	1 1	5 3	3 6 8	4 5 8	1 2 2	2 4

State Name: Montana

Urbanized Area Name: Great Falls

Figure No. 15

1990
INDIVIDUAL URBANIZED AREA DATA SUMMARY

Card Number	Urban Functional Classification	Total						Federal-aid primary		Federal-aid secondary		Non-federal-aid		Urbanized Area Code	State Code
		Mileage			Travel										
		Miles	% of Total	Cumulative % of Total	Daily vehicle miles of travel (thousands)	% of Total	Cumulative % of Total	Miles	Daily vehicle miles of travel (thousands)	Miles	Daily vehicle miles of travel (thousands)	Miles	Daily vehicle miles of travel (thousands)		
1 2		3 4 5 6 7 8 9			12 13 14 15 16 17 18 19			22 23 24 25 26	29 30 31 32 33 34 35 36	39 40 41 42 43	46 47 48 49 50 51 52 53	56 57 58 59 60 61	64 65 66 67 68	76 77 78	79 80
	Principal arterial system														
4 1	Interstate	9 8	1.7	1.7	111	12.2	12.2	8	111	0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0 0 0	410	24
4 2	Other freeways and expressways	9 0	0	1.7	0	0	12.2	0	0	0	0	0	0	410	24
4 3	Other principal arterials	9 20	4.3	6.0	240	26.4	38.6	14	189	6	51	0	0	410	24
4 4	Minor arterial street system	9 44	9.4	15.4	237	26.1	64.7	3	35	23	122	18	80	410	24
4 5	Collector street system	9 42	9.0	24.4	115	12.6	77.3	0	0	4	15	38	100	410	24
4 6	Local street system	9 353	75.6	100.0	206	22.7	100.0	0	0	0	0	353	206	410	24
4 7	Total	9 467	100.0	-	909	100.0	-	25	335	33	188	409	386	410	24

State Name: Montana

Urbanized Area Name: Missoula

Figure No. 16

1990
SMALL URBAN AREA DATA SUMMARY — 25,000 TO 49,999 POPULATION

Card Number	Urban Functional Classification	Total					Federal-aid primary		Federal-aid secondary		Non federal-aid		State Code
		Mileage			Travel								
		Miles	% of Total	Cumulative % of Total	Daily vehicle miles of travel (thousands)	% of Total	Cumulative % of Total	Miles	Daily vehicle miles of travel (thousands)	Miles	Daily vehicle miles of travel (thousands)	Miles	Daily vehicle miles of travel (thousands)	
1 2		3 4 5 6 7 8 9			12 13 14 15 16 17 18 19			22 23 24 25 26	29 30 31 32 33 34 35 36	39 40 41 42 43	46 47 48 49 50 51 52 53	56 57 58 59 60 61	64 65 66 67 68 69 70 71	79 80
	Principal arterial system													
3 1	Interstate	9 23	2.8	2.8	1 6 9	20.8	20.8	23	1 6 9	0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0 0 0	24
3 2	Other freeways and expressways	9 0	0	2.8	0	0	20.8	0	0	0	0	0	0	24
3 3	Other principal arterials	9 48	5.9	8.7	2 6 0	32.1	52.9	35	2 2 4	5	2 2	8	1 4	24
3 4	Minor arterial street system	9 65	7.9	16.6	1 2 1	14.9	67.8	9	2 1	2 1	3 2	3 5	6 8	24
3 5	Collector street system	9 78	9.5	26.1	9 0	11.1	78.9	1	2	6	9	7 1	7 9	24
3 6	Local street system	9 605	73.9	100.0	1 7 1	21.1	100.0	0	0	0	0	6 0 5	1 7 1	24
3 7	Total	9 819	100.0	-	8 1 1	100.0	-	68	4 1 6	32	6 3	7 1 9	3 3 2	24

State Name: Montana

Butte
Helena
Bozeman
Kalispell

Figure No. 17

1990
SMALL URBAN AREA DATA SUMMARY — 10,000 TO 24,999 POPULATION

Card Number	Urban Functional Classification	Total: Mileage: Miles	Total: Mileage: % of Total	Total: Mileage: Cumulative % of Total	Total: Travel: Daily vehicle miles of travel (thousands)	Total: Travel: % of Total	Total: Travel: Cumulative % of Total	Federal-aid primary: Miles	Federal-aid primary: Daily vehicle miles of travel (thousands)	Federal-aid secondary: Miles	Federal-aid secondary: Daily vehicle miles of travel (thousands)	Non-federal-aid: Miles	Non-federal-aid: Daily vehicle miles of travel (thousands)	State Code
1 2	3 4 5 6 7 8 9				12 13 14 15 16 17 18 19			22 23 24 25 26	29 30 31 32 33 34 35 36	39 40 41 42 43	46 47 48 49 50 51 52 53	56 57 58 59 60 61	64 65 66 67 68 69 70 71	79 80
	Principal arterial system													
2 1	Interstate 9	0	0	0	0	0	0	0	0	0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0 0 0	2 4
2 2	Other freeways and expressways 9	0	0	0	0	0	0	0	0	0	0	0	0	2 4
2 3	Other principal arterials 9	19	10.7	10.7	9	57.2	57.2	16	83	2	6	1	2	2 4
2 4	Minor arterial street system 9	14	7.9	18.6	21	13.2	70.4	1	2	2	3	11	16	2 4
2 5	Collector street system 9	18	10.1	28.7	19	12.0	82.4	0	0	0	0	18	19	2 4
2 6	Local street system 9	127	71.3	100.0	28	17.6	100.0	0	0	0	0	127	28	2 4
2 7	Total 9	178	100.0	-	159	100.0	-	17	85	4	9	157	65	2 4

State Name: Montana

Havre
Miles City
Anaconda

Figure No. 18

1990
SMALL URBAN AREA DATA SUMMARY – 5,000 TO 9,999 POPULATION

Card Number	Urban Functional Classification	Total						Federal-aid primary		Federal-aid secondary		Non-federal-aid			State Code
		Mileage			Travel										
		Miles	% of Total	Cumulative % of Total	Daily vehicle miles of travel (thousands)	% of Total	Cumulative % of Total	Miles	Daily vehicle miles of travel (thousands)	Miles	Daily vehicle miles of travel (thousands)	Miles	Daily vehicle miles of travel (thousands)		
1 2	3 4 5 6 7 8 9				12 13 14 15 16 17 18 19			22 23 24 25 26	29 30 31 32 33 34 35 36	39 40 41 42 43	46 47 48 49 50 51 52 53	56 57 58 59 60 61	64 65 66 67 68 69 70 71		79 80
	Principal arterial system														
1 1	Interstate 9	2	0.5	0.5	15	5.0	5.0	2	15	0 0 0 0 0	0 0 0 0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0 0 0		2 4
1 2	Other freeways and expressways 9	0	0	0.5	0	0	5.0	0	0	0	0	0	0		2 4
1 3	Other principal arterials 9	38	10.5	11.0	139	46.3	51.3	37	136	1	3	0	0		2 4
1 4	Minor arterial street system 9	30	8.3	19.3	33	11.0	62.3	3	6	7	8	20	19		2 4
1 5	Collector street system 9	41	11.3	30.6	43	14.3	76.6	0	0	0	0	41	43		2 4
1 6	Local street system 9	252	69.4	100.0	70	23.4	100.0	0	0	0	0	252	70		2 4
1 7	Total 9	363	100.0	–	300	100.0	–	42	157	8	11	313	132		2 4

State Name: Montana

Libby
Livingston
Lewistown
Glendive
Dillon
Laurel
Glasgow
Sidney

Figure No. 19

1990

URBAN CONNECTING LINK SUMMARY [1/]

Card Number	Connecting Link Mileage Summary				Connecting Link Travel Summary (Daily VMT in Thousands)				1990 Land Area in Square Miles	1990 Population (thousands)	No. of Small Urban Areas in This Strata	Urbanized Area Code	State Code
	Other Freeways and Expressways		Other Urban Principal Arterials		Other Freeways and Expressways		Other Urban Principal Arterials						
	Connectg. Lnks. of Rural Prin. Arterial Sys.	Connectg. Lnks. of Rural Min. Arterial Sys.	Connectg. Lnks. of Rural Prin. Arterial Sys.	Connectg. Lnks. of Rural Min. Arterial Sys.	Connectg. Lnks. of Rural Princ. Arterial Sys.	Connectg. Lnks. of Rural Minor Arterial Sys.	Connectg. Lnks. of Rural Princ. Arterial Sys.	Connectg. Lnks. of Rural Minor Arterial Sys.					
03	0	0	0	0	0	0	0	0	145492	3510	000	09000	24
18	0	0	14	9	0	0	60	39	30	54	8	09000	24
28	0	0	3	11	0	0	28	55	13	35	3	09000	24
38	0	0	23	5	0	0	189	15	68	134	4	09000	24
48	0	0	8	6	0	0	73	67	54	107	000	090	1212
48	0	0	16	0	0	0	190	0	37	102	000	090	1222
48	0	0	7	0	0	0	102	0	43	77	000	090	4102
48											000	090	
48											000	090	
48											000	090	
48											000	090	
48											000	090	
48											000	090	
48											000	090	
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48											000	090	
48											000	090	
48											000	090	
48											000	090	
48											000	090	

[1/] This form, containing 1990 data, shall be completed as follows:

A) Card number 08 shall be completed for the entire rural portion of the State – land area and population only.
B) Card number 18 shall be completed for small urban areas of 5,000 to 9,999 population – one card shall be completed per State.
C) Card number 28 shall be completed for small urban areas of 10,000 to 24,999 population – one card shall be completed per State.
D) Card number 38 shall be completed for small urban areas of 25,000 to 49,999 population – one card shall be completed per State.
E) Card number 48 shall be completed for each urbanized area (or portion thereof) within the State.

Figure No. 20

1990 STATEWIDE ROUTE LOG

Page 1 of 4

State Code	Study Route Number	Route Segment	Type Area	Signed Route Number	Description From / To	Rural Mileage (xxxxxx.x)	Urban Mileage (xxxxx.x)	Present ADT	1990 ADT	Road Type	Acc. Cont.	No. of Lanes	Card No.
24	2001	001	1	US2	IDAHO SL to WUL LIBBY	300		1480	2141	U	3	02	1
24	2001	002	2	US2	WUL LIBBY to EUL LIBBY		68	3779	4441	U	3	04	1
24	2001	003	1	US2	EUL LIBBY to WUL KALISPELL	819		950	1506	U	3	02	1
24	2001	004	4	US2	WUL KALISPELL to JCT US93		21	3059	3762	U	3	04	1
24	2001	005	4	US2	JCT US93 to EUL KALISPELL		34	7418	9112	D	3	04	1
24	2001	006	1	US2	EUL KALISPELL to I015	1544		1185	1849	U	3	02	1
24	2001	007	1	US2	I015 to US87	1007		1037	1639	U	3	02	1
24	2001	008	1	US2	US87 to WUL HAVRE	13		4064	6443	U	3	02	1
24	2001	009	3	US2	WUL HAVRE to EUL HAVRE		34	5146	8235	U	3	02	1
24	2001	010	1	US2	EUL HAVRE to WUL GLASGOW	1560		1210	1921	U	3	02	1
24	2001	011	2	US2	WUL GLASGOW to EUL GLASGOW		24	4292	5708	D	3	04	1
24	2001	012	1	US2	EUL GLASGOW to S13W	473		1157	1829	U	3	02	1
24	2001	013	1	US2	S13W to NORTH DAKOTA SL	766		1000	1521	U	3	02	1
24	2001			US2		6482	181						2
24	2001	001	1	US12	I094 MILES CITY to NORTH DAKOTA SL	893		560	665	U	3	02	1
24	2002			US12		893	000						2
24	2004	001	2	US310	I090 to SUL LAUREL		007	3175	3857	D	3	04	1
24	2004	002	1	US310	SUL LAUREL to WYO SL	536		1446	2079	U	3	02	1
24	2004			US310		536	007						2

Figure No. 20 (Cont.)

1990 STATEWIDE ROUTE LOG

Page 2 of 4

State Code	Study Route Number	Route Segment	Type Area	Signed Route Number	Description From / To	Rural Mileage (xxxxxx.x)	Urban Mileage (xxxxx.x)	Present ADT	1990 ADT	Road Type	Acc. Cont.	No. of Lanes	Card No.
24	2005	001	1	US93	I090 W MISSOULA to SUL KALISPELL	1095		2124	3379	U	3	02	1
24	2005	002	4	US93	SUL KALISPELL to US2		30	6511	8000	U	3	02	1
24	2005			US93		1095	30						2
24	2007	001	5	US93	I090 to SUL MISSOULA		66	7596	15454	U	3	04	1
24	2007	002	1	US93	SUL MISSOULA to US12	115		4223	8190	D	2	04	1
24	2007	003	1	US93	US12 to IDAHO SL	768		1578	3084	U	3	02	1
24	2007			US93		883	66						2
24	2008	001	1	US12	I090 to WUL HELENA	400		1159	1985	U	3	02	1
24	2008	002	4	US12	WUL HELENA to I015		78	7340	9051	D	2	04	1
24	2008	003	4	US12	I015 to EUL HELENA		20	5060	6200	D	2	04	1
24	2008	004	1	US287	EUL HELENA to I090	617		1458	2297	U	3	02	1
24	2008			US287		1017	98						2
24	2010	001	5	US87	I015 to FAP 40		12	11533	13972	D	3	04	1
24	2040	002	5	US87	FAP 10 @ CENTRAL to FAP 10 @ NINTH		19	8753	11192	D	3	04	1
24	2010	003	5	US87	FAP 41 to NUL GT FALLS		53	5747	8186	U	3	02	1
24	2010	004	1	US87	NUL GT FALLS to US2	1076		1085	1901	U	3	02	1
24	2010			US87		1076	84						2
24	2003	001	5	US87	I315 to FAP 41		11	13811	16250	U	1	02	1
24	2041	002	5	US87	FAP 3 to FAP 11		38	18086	20525	D	3	04	1
24	2011	003	5	US87	FAP 41 to EUL GT FALLS		22	3340	5779	D	3	04	1

Figure No. 20 (Cont.)

1990 STATEWIDE ROUTE LOG

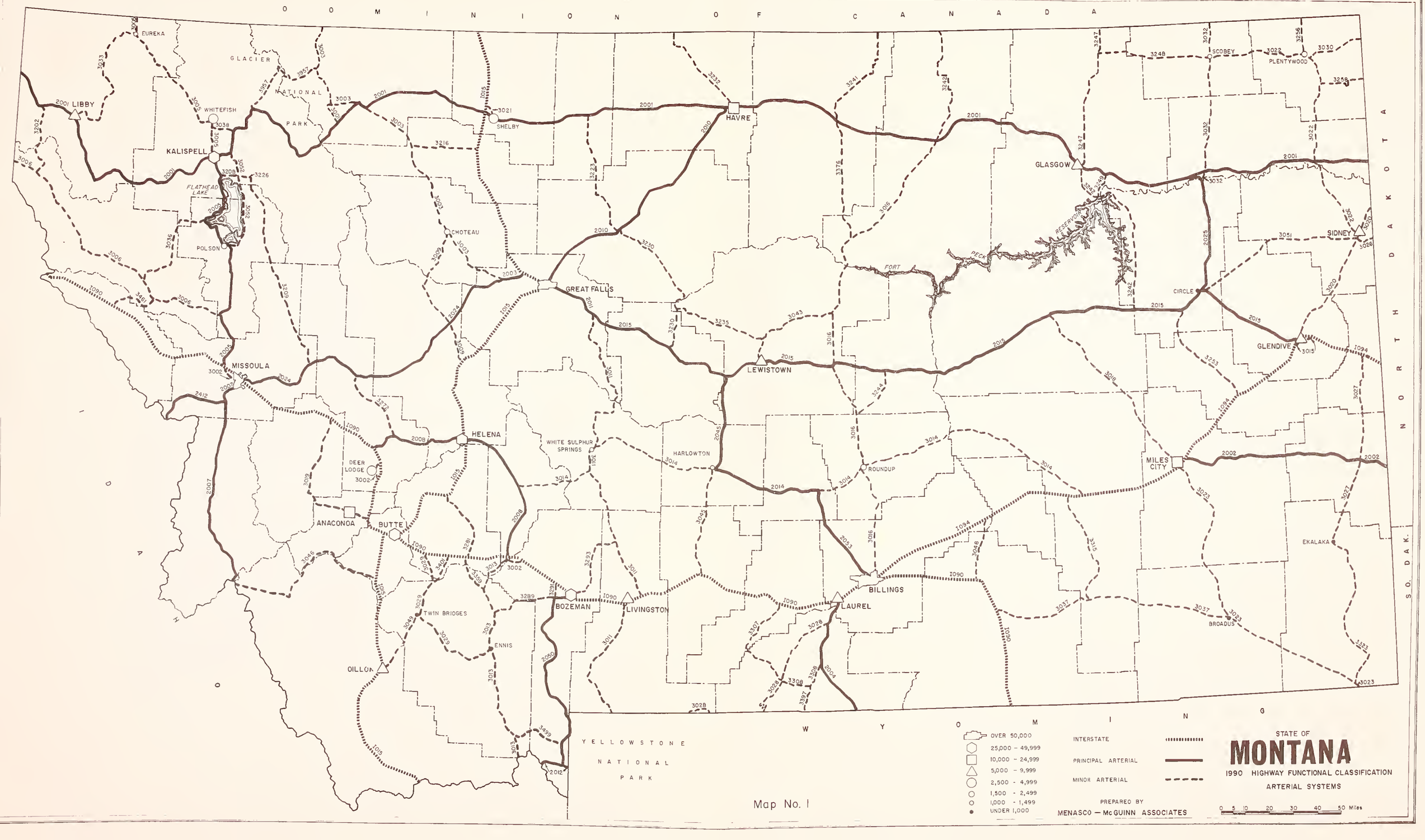
State Code	Study Route Number	Route Segment	Type Area	Signed Route Number	Description From / To	Rural Mileage (xxxxxx.x)	Urban Mileage (xxxxx.x)	Present ADT	1990 ADT	Road Type	Acc. Cont.	No. of Lanes	Card No.
24	2011	004	1	US 87	EUL GT FALLS to JCT US 87 & US 89	1.74		2199	4918	U	3	02	1
24	2011			US 87		1.74	7.1						2
24	2012	001	1	US 191	IDAHO SL to YELLOWSTONE NAT. PARK	.98		1911	2991	U	3	02	1
24	2012	002	1	US 191	YELLOWSTONE PARK BND to WYO SL	.23		1911	2991	U	3	02	1
24	2012			US 191		1.21	0.0						2
24	2014	001	1	US 12	JCT US 191 HARLOWTON to S3	4.51		907	1301	U	3	02	1
24	2014			US 12		4.51	0.0						2
24	2015	001	1	US 87	JCT US 87 & US 89 to US 191	6.48		1304	1867	U	3	02	1
24	2015	002	1	US 87	US 191 to WUL LEWISTOWN	1.40		1518	2173	U	3	02	1
24	2015	003	2	US 87	WUL LEWISTOWN to EUL LEWISTOWN		4.0	2707	3350	U	3	02	1
24	2015	004	1	S 200	EUL LEWISTOWN to S13	1.952		400	571	U	3	02	1
24	2015	005	1	S 200 S	S13 to I094	4.57		591	848	U	3	02	1
24	2015					3.197	4.0						2
24	2002	001	1	S 200	BONNER INTG SE to FAP 24	.8		1175	2257	U	3	02	1
24	2024	002	1	S 200	JCT FAP 2 & FAP 24 N to I015	1.471		1175	2257	U	3	02	1
24	2024			S 200		1.479	0.0						2
24	2025	001	1	S 13	US 200 CIRCLE to US 2 WOLF POINT	5.30		686	1029	U	3	02	1
24	2025			S 13		5.30	0.0						2
24	2045	001	1	US 191	US 12 HARLOWTON to US 87	3.92		713	1012	U	3	02	1
24	2045			US 191		3.92	0.0						2

Figure No. 20 (Cont.)

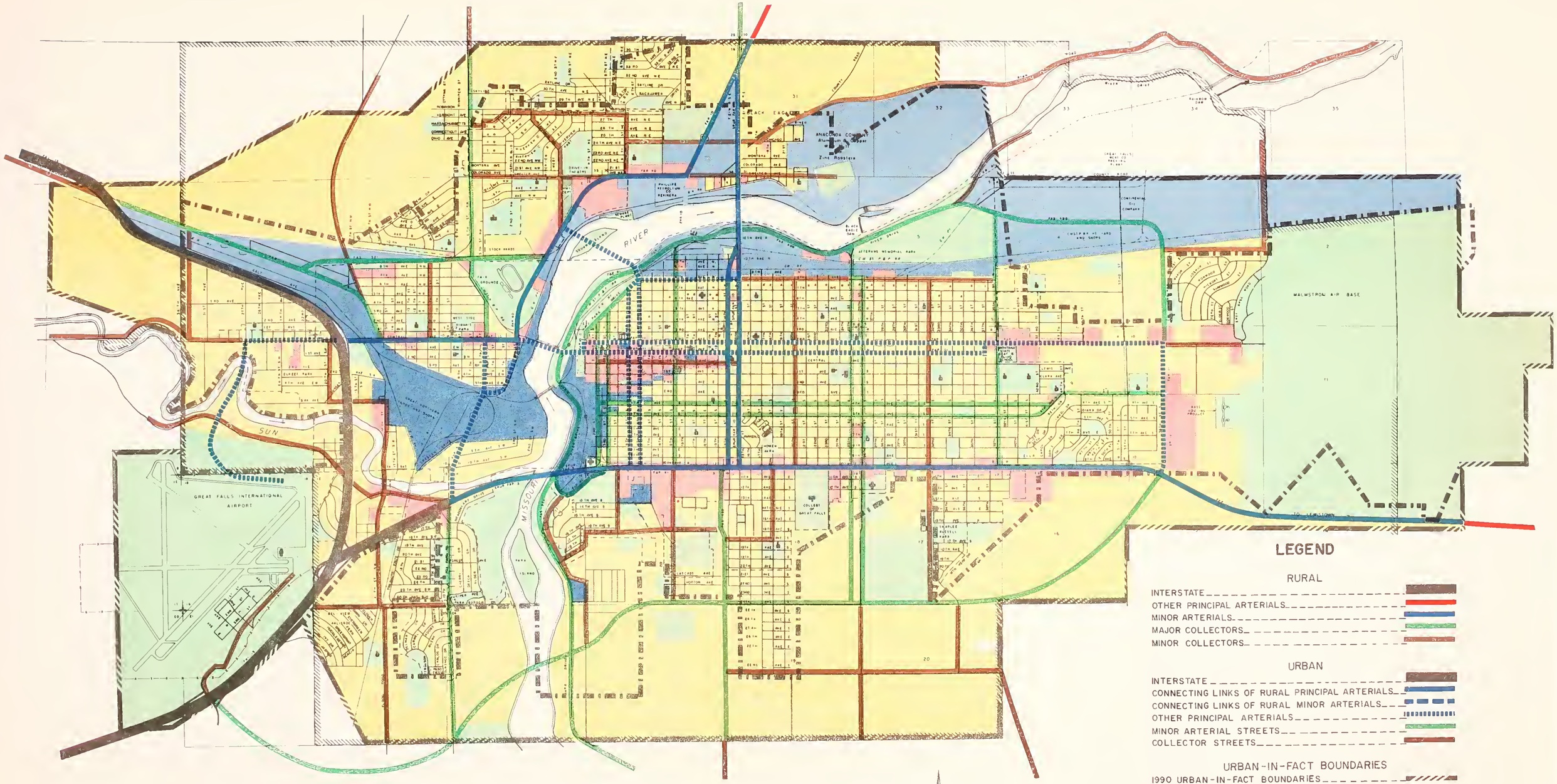
1990 STATEWIDE ROUTE LOG

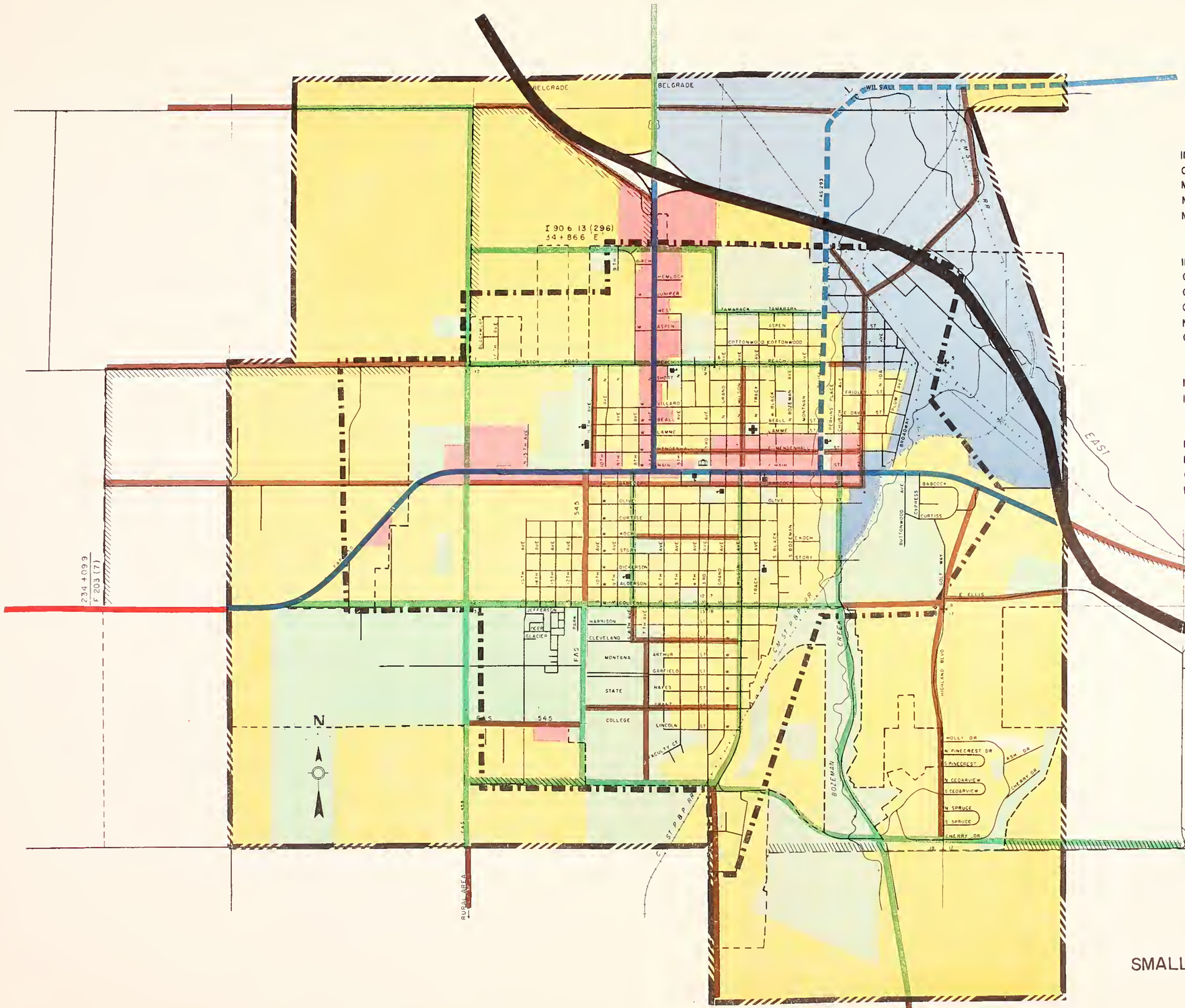
Page 4 of 4

State Code	Study Route Number	Route Segment	Type Area	Signed Route Number	Description From / To	Rural Mileage (xxxxxx.x)	Urban Mileage (xxxxx.x)	Present ADT	1990 ADT	Road Type	Acc. Cont.	No. of Lanes	Card No.
24	2050	001	1	US191	US191 W YELLOWSTONE to WUL BOZEMAN	870		981	2102	U	3	02	1
24	2050	002	4	US191	WUL BOZEMAN to FAP 2		20	5322	6600	U	3	02	1
24	2002	003	4	US191	FAP 2 to I090		30	8119	10000	U	3	04	1
24	2050			US191		870	50						2
24	2053	001	5	S3	I090 BILLINGS to NUL BILLINGS		80	3813	9125	U	3	04	1
24	2053	002	1	S3	NUL BILLINGS to US12	391		830	1190	U	3	02	1
24	2053			S3		391	80						2
24	2412	001	1	US12	US93 to IDAHO SL	326		504	884	U	3	02	1
24	2412			US12		326	00						2
						1913	707					1	3


D O M I N I O N O F C A N A D A
NORTH DAKOTA
S. DAK.
WYOMING
IDAHO
EUREKA
GLACIER NATIONAL PARK
LIBBY
WHITEFISH
KALISPELL
FLATHEAD LAKE
POLSON
SHELBY
HAVRE
CHOTEAU
GREAT FALLS
GLASGOW
SCOBEY
PLENTYWOOD
SIDNEY
CIRCLE
GLENDIVE
FORT PECK RESERVOIR
MISSOULA
HELENA
WHITE SULPHUR SPRINGS
DEER LODGE
ANACONDA
BUTTE
TWIN BRIDGES
ENNIS
BOZEMAN
LIVINGSTON
LEWISTOWN
HARLOWTON
ROUNDUP
BILLINGS
LAUREL
MILES CITY
BROADUS
EKALAKA
YELLOWSTONE NATIONAL PARK
OVER 50,000
25,000 - 49,999
10,000 - 24,999
5,000 - 9,999
2,500 - 4,999
1,500 - 2,499
1,000 - 1,499
UNDER 1,000
INTERSTATE
PRINCIPAL ARTERIAL
MINOR ARTERIAL
PREPARED BY
MENASCO — McGUINN ASSOCIATES
STATE OF
MONTANA
1990 HIGHWAY FUNCTIONAL CLASSIFICATION
ARTERIAL SYSTEMS
0 5 10 20 30 40 50 Miles

Map No. 1


RIVER
SUN
MISSOURI
GREAT FALLS INTERNATIONAL AIRPORT
MALMSTROM AIR BASE
ANACONDA COMPANY
Aluminum
Copper
Zinc Rossleia
PHILLIPS PETROLEUM CO REFINERY
BLACK EAGLE
GREAT FALLS
URBANIZED AREA SYSTEMS MAP
MAP NO. 2
N
LEGEND
RURAL
INTERSTATE
OTHER PRINCIPAL ARTERIALS
MINOR ARTERIALS
MAJOR COLLECTORS
MINOR COLLECTORS
URBAN
INTERSTATE
CONNECTING LINKS OF RURAL PRINCIPAL ARTERIALS
CONNECTING LINKS OF RURAL MINOR ARTERIALS
OTHER PRINCIPAL ARTERIALS
MINOR ARTERIAL STREETS
COLLECTOR STREETS
URBAN-IN-FACT BOUNDARIES
1990 URBAN-IN-FACT BOUNDARIES
1968 URBAN IN FACT BOUNDARIES
LAND USE
RESIDENTIAL
PUBLIC LANDS
COMMERCIAL
INDUSTRIAL



LEGEND

RURAL

- INTERSTATE
- OTHER PRINCIPAL ARTERIALS
- MINOR ARTERIALS
- MAJOR COLLECTORS
- MINOR COLLECTORS

URBAN

- INTERSTATE
- CONNECTING LINKS OF RURAL PRINCIPAL ARTERIALS
- CONNECTING LINKS OF RURAL MINOR ARTERIALS
- OTHER PRINCIPAL ARTERIALS
- MINOR ARTERIAL STREETS
- COLLECTOR STREETS

URBAN-IN-FACT BOUNDARIES

- 1990 URBAN-IN-FACT BOUNDARIES
- 1968 URBAN IN FACT BOUNDARIES

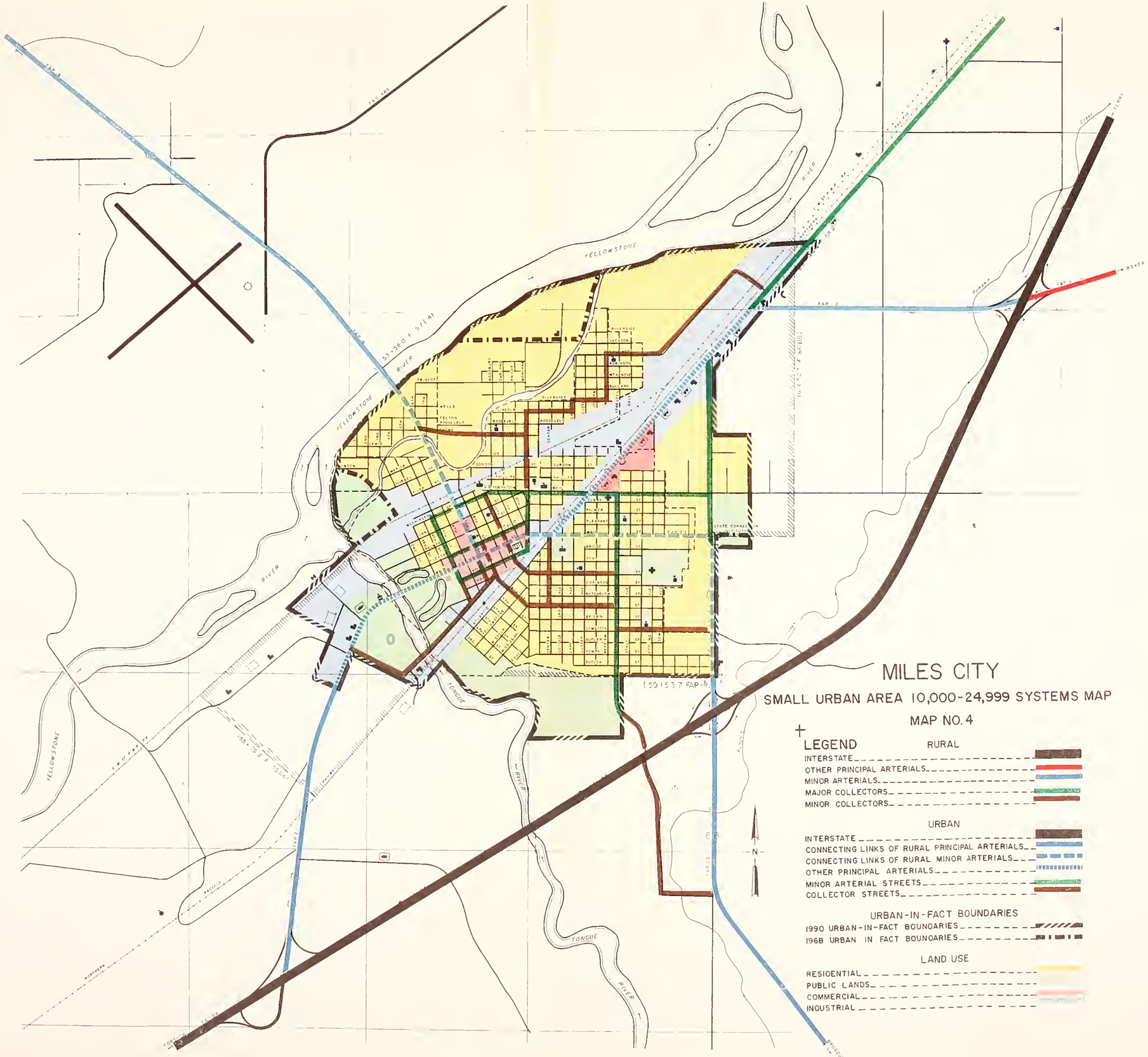
LAND USE

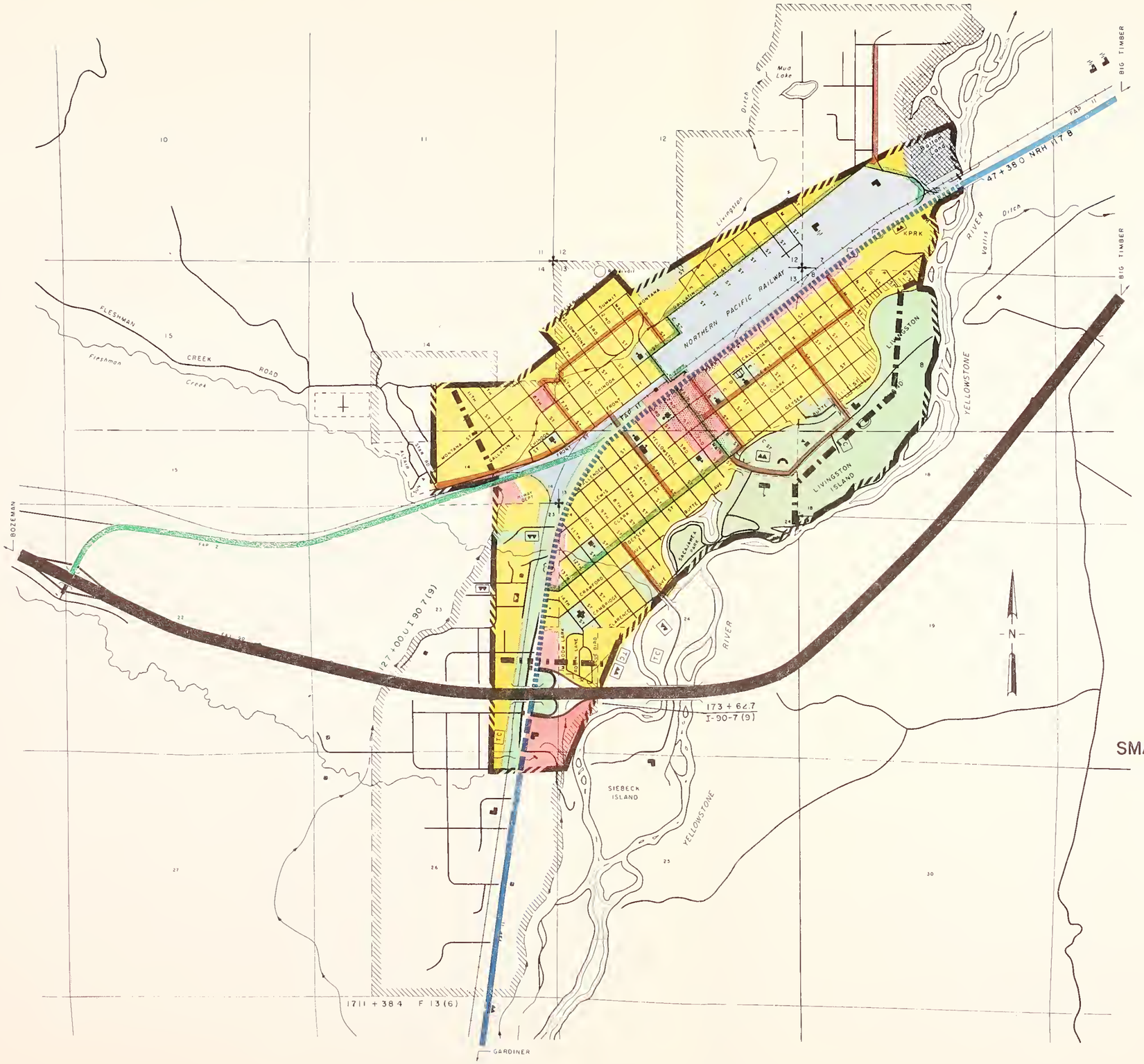
- RESIDENTIAL
- PUBLIC LANDS
- COMMERCIAL
- INDUSTRIAL

BOZEMAN

SMALL URBAN AREA 25,000–49,999 SYSTEMS MAP

MAP NO. 3


YELLOWSTONE RIVER
TONGUE RIVER
(5915.37 FAP-8)
N
MILES CITY
SMALL URBAN AREA 10,000-24,999 SYSTEMS MAP
MAP NO. 4
LEGEND
RURAL
INTERSTATE
OTHER PRINCIPAL ARTERIALS
MINOR ARTERIALS
MAJOR COLLECTORS
MINOR COLLECTORS
URBAN
INTERSTATE
CONNECTING LINKS OF RURAL PRINCIPAL ARTERIALS
CONNECTING LINKS OF RURAL MINOR ARTERIALS
OTHER PRINCIPAL ARTERIALS
MINOR ARTERIAL STREETS
COLLECTOR STREETS
URBAN-IN-FACT BOUNDARIES
1990 URBAN-IN-FACT BOUNDARIES
1968 URBAN IN FACT BOUNDARIES
LAND USE
RESIDENTIAL
PUBLIC LANDS
COMMERCIAL
INDUSTRIAL



LEGEND

RURAL

- INTERSTATE
- OTHER PRINCIPAL ARTERIALS
- MINOR ARTERIALS
- MAJOR COLLECTORS
- MINOR COLLECTORS

URBAN

- INTERSTATE
- CONNECTING LINKS OF RURAL PRINCIPAL ARTERIALS
- CONNECTING LINKS OF RURAL MINOR ARTERIALS
- OTHER PRINCIPAL ARTERIALS
- MINOR ARTERIAL STREETS
- COLLECTOR STREETS

URBAN-IN-FACT BOUNDARIES

- 1990 URBAN-IN-FACT BOUNDARIES
- 1968 URBAN IN FACT BOUNDARIES

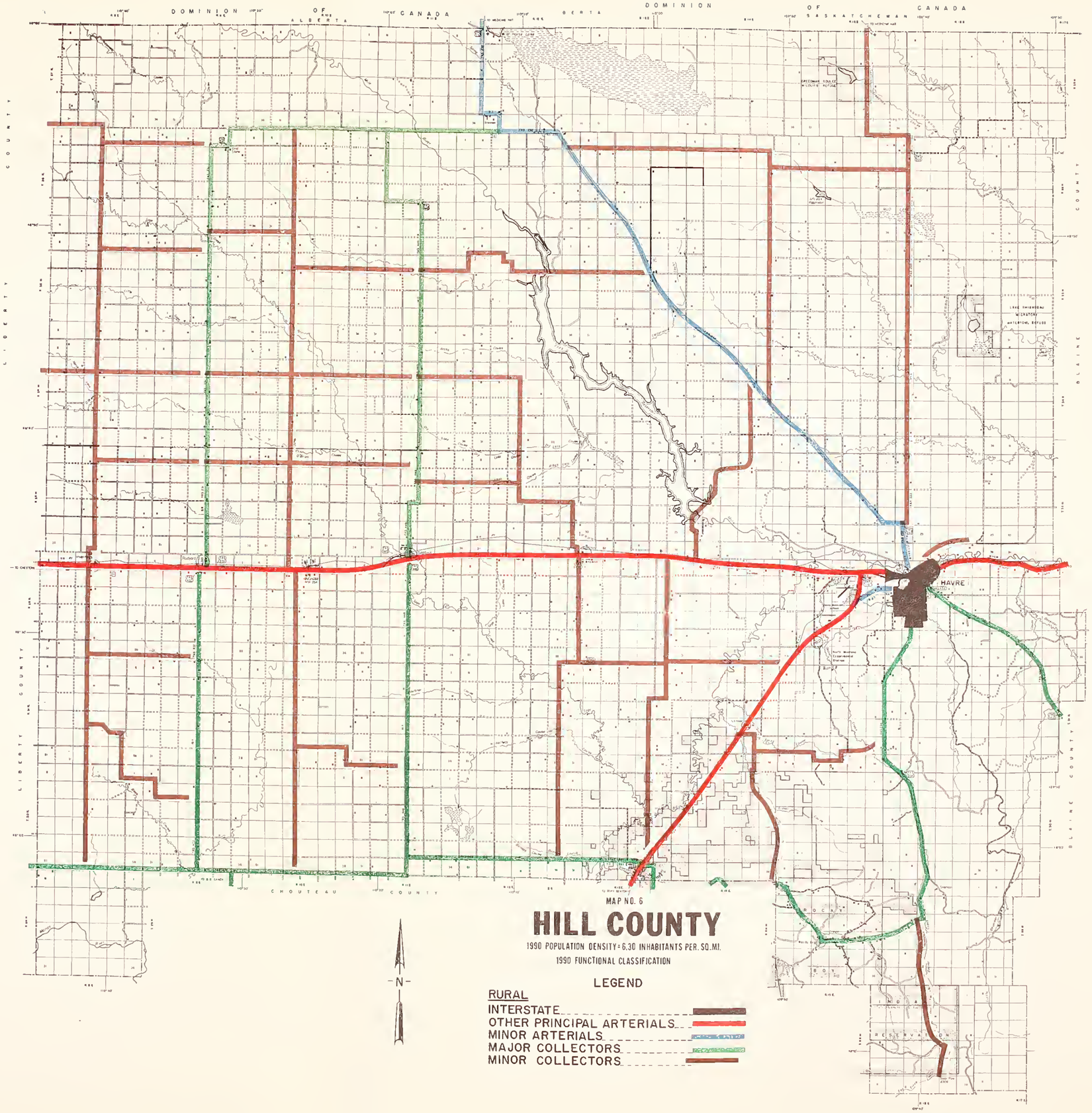
LAND USE

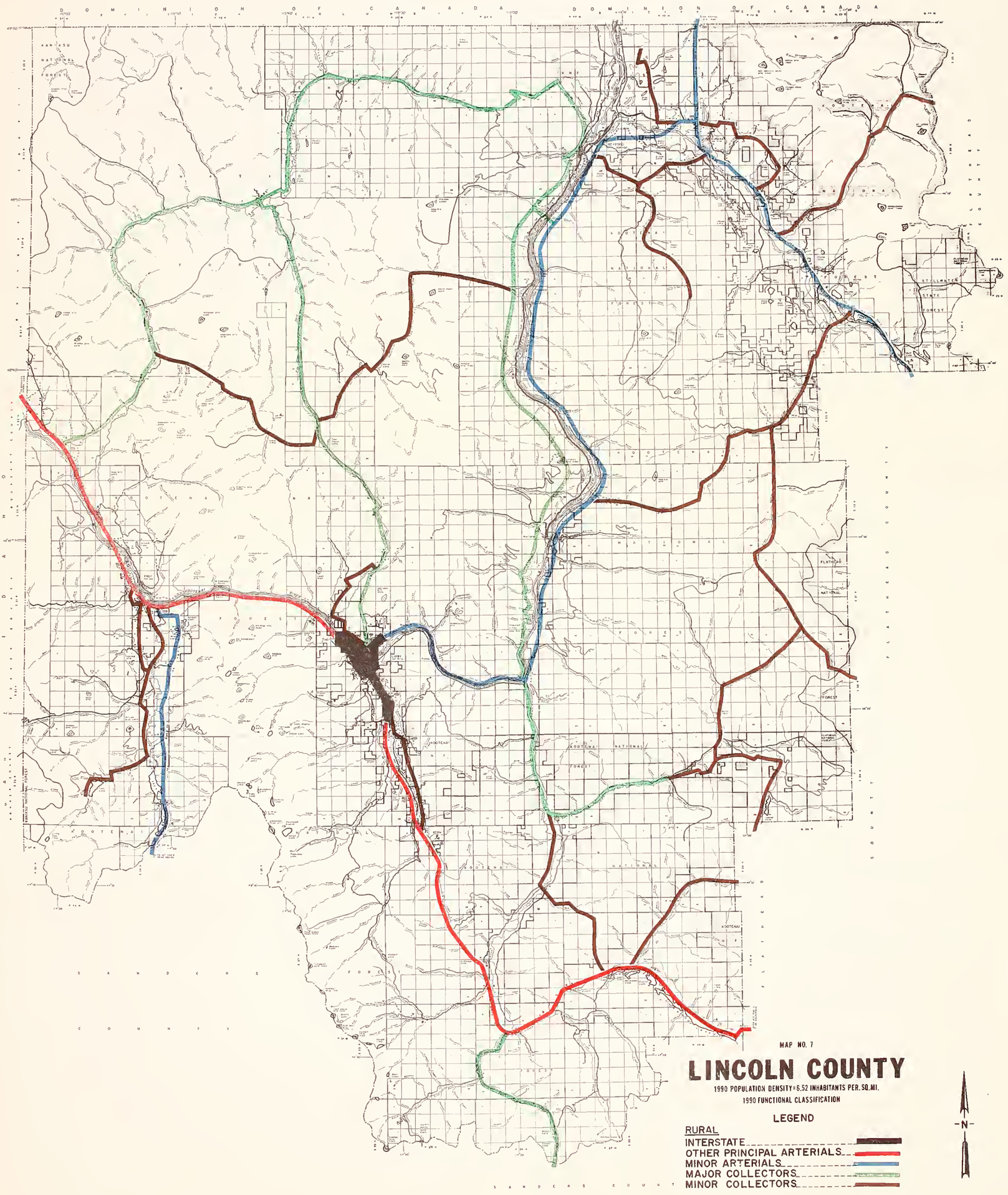
- RESIDENTIAL
- PUBLIC LANDS
- COMMERCIAL
- INDUSTRIAL

LIVINGSTON

SMALL URBAN AREA 5,000–9,999 SYSTEMS MAP

MAP NO. 5


DOMINION OF CANADA
ALBERTA
SASKATCHEWAN
LIBERTY COUNTY
BLAINE COUNTY
CHOUTEAU COUNTY
HAVRE
N
MAP NO. 6
HILL COUNTY
1990 POPULATION DENSITY = 6.30 INHABITANTS PER SQ.MI.
1990 FUNCTIONAL CLASSIFICATION
LEGEND
RURAL
INTERSTATE
OTHER PRINCIPAL ARTERIALS
MINOR ARTERIALS
MAJOR COLLECTORS
MINOR COLLECTORS



MAP NO. 7

LINCOLN COUNTY

1990 POPULATION DENSITY=6.52 INHABITANTS PER SQ.MI.

1990 FUNCTIONAL CLASSIFICATION

LEGEND

RURAL

- INTERSTATE
- OTHER PRINCIPAL ARTERIALS
- MINOR ARTERIALS
- MAJOR COLLECTORS
- MINOR COLLECTORS

N

MAP NO. 8

MISSOULA COUNTY

1990 POPULATION DENSITY=34.32 INHABITANTS PER. SQ. MI.

1990 FUNCTIONAL CLASSIFICATION

LEGEND

RURAL

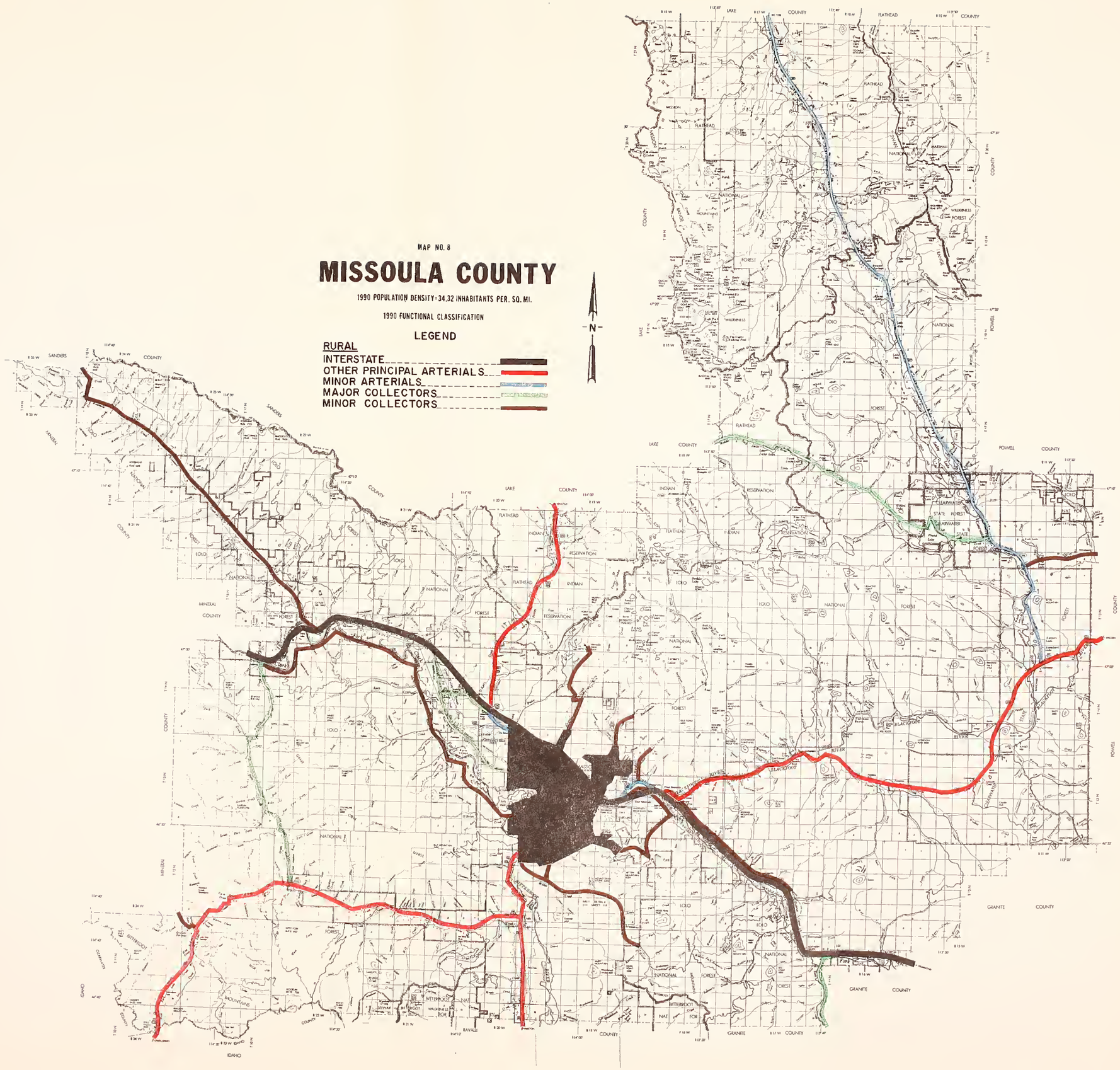
INTERSTATE

OTHER PRINCIPAL ARTERIALS

MINOR ARTERIALS

MAJOR COLLECTORS

MINOR COLLECTORS



MAP NO. 9

WHEATLAND COUNTY

1990 POPULATION DENSITY=1.85 INHABITANTS PER. SQ.MI.

1990 FUNCTIONAL CLASSIFICATION

LEGEND

RURAL

- INTERSTATE
- OTHER PRINCIPAL ARTERIALS
- MINOR ARTERIALS
- MAJOR COLLECTORS
- MINOR COLLECTORS

N

APPENDIX B

APPENDIX 'B'

I. Estimating Unit and Per–Mile Costs

A. Cost Areas

B. Design Standards

C. Development of Average Costs Per Mile

D. Type of Improvement

E. Tables of Average Costs Per Mile

Figure No. 21 ..... Relationship of Development Data to Design Standards – I

Figure No. 22 ..... Relationship of Development Data to Design Standards – II

Table No. 12 ..... Rural Construction Cost Summary No. 1

Table No. 13 ..... Rural Construction Cost Summary No. 2

Table No. 14 ..... Rural Right-of-Way Cost Summary No. 1

Table No. 15 ..... Rural Right-of-Way Cost Summary No. 2

Table No. 16 ..... Urban Construction Cost Summary No. 1

Table No. 17 ..... Urban Construction Cost Summary No. 2

Table No. 18 ..... Urban Construction Cost Summary No. 3

I. ESTIMATING UNIT AND PER–MILE COSTS

A. Cost Areas

The first step in the cost analysis involved an examination of how construction costs varied according to geographical areas within the State. An examination indicated that costs in the predominately mountainous western part of the State were generally higher than those in the flatter eastern areas. To determine the validity and consistency of this theory, the State was divided, along county lines, into the two cost areas shown on Figure No. 4. Using the 118 projects mentioned in the information outline, average costs for three construction categories were computed for each of the cost areas. These costs were then compared to combined or state-wide average costs. The following indices show the results of these comparisons the base index 1.000 being the combined or state-wide average costs in each construction category.

(1) Base and Surfacing Costs

Cost Area One Index 1.0908

Cost Area Two Index 0.9156

(Index compares average unit costs of 21 paving items for all projects combined.)

(2) Grading and Drainage Costs

	F.A.I.	F.A.P.	F.A.S.
Cost Area One Index	1.1133	1.1695	1.4397
Cost Area Two Index	0.8782	0.8958	0.8342

(Index based on average cost per mile.)

(3) All Other Construction Costs

	F.A.I.	F.A.P.	F.A.S.
Cost Area One Index	1.7900	1.3623	1.0120
Cost Area Two Index	0.8232	0.9193	0.9944

(Index based on average cost per mile.)

It can be seen from these comparisons that for the cost areas shown on Figure No. 4, the difference in costs in the various categories is reasonably consistent. In all cases, Cost Area One average costs are consistently higher than the state-wide average costs, while those in Cost Area Two are consistently lower.

This cost area analysis applies only to the **rural** portion of the needs appraisal. Separate sets of costs were developed for each of the three urbanized areas (over 50,000 population by 1990), and another for all small urban areas having a 1990 population of 5,000 to 49,999.

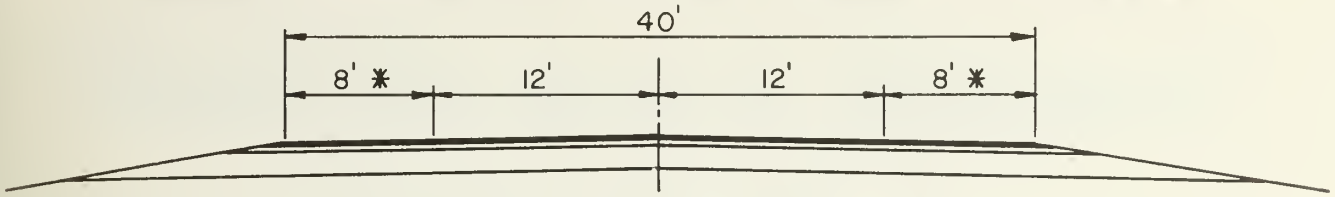
B. Design Standards

A set of 44 design standards was used in estimating the cost of needed improvements on the deficient sections (see Tables No. 9, 10, and 11). These standards are intended to provide Nationwide consistency in the cost portion of the needs appraisal, and to relate the cost per mile to functional classification, rural terrain or urban development, and traffic volume. Individual costs per mile for the various construction categories and types of improvement were developed for each of the 44 design standards.

The design standards were then related to the federal-aid interstate, primary, and secondary projects which were used to develop the costs. Base and surfacing costs were developed from quantities calculated from typical sections for each design standard. To obtain grading and drainage and 'other' costs, it was necessary to correlate the design standards to projects having similar grading and drainage characteristics, as well as similar 'other' costs. The manner in which rural design standards were related to two-lane primary and secondary projects is shown in Figures No. 21 and 22. Since the rural four-lane design standards are nearly identical to interstate standards, the rural four-lane costs were developed directly from interstate project information.

RELATIONSHIP OF DEVELOPMENT DATA TO DESIGN STANDARDS – I

TYPICAL FEDERAL AID PRIMARY DESIGN STANDARD

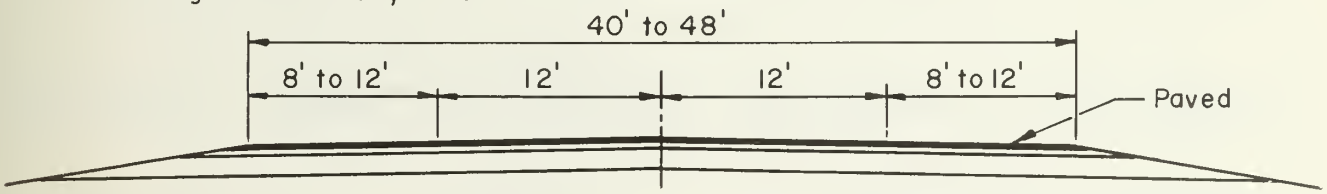


* Variable from 2' to 10'; 8' is average used on 1968 – 1969 projects

COMPARABLE FUNCTIONAL CLASSIFICATION DESIGN STANDARDS

1. RURAL PRINCIPAL ARTERIALS

Design Std. No's. 1, 2 & 3



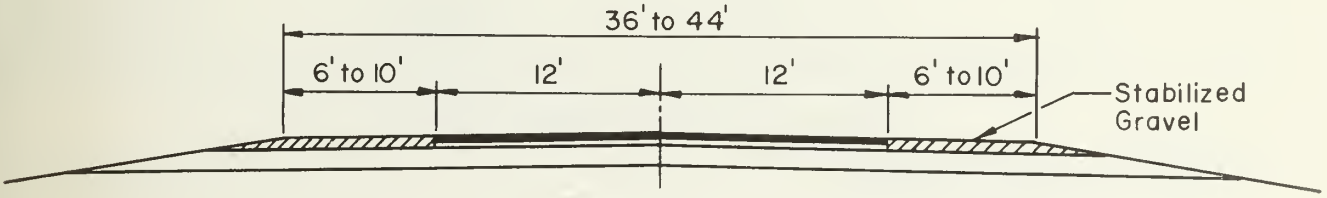
DESIGN STD. NO.	TERRAIN	SURFACE TYPE	SHOULDERS
1	Flat	High	12' Paved
2	Rolling	High	10' Paved
3	Mountainous	High	8' Paved

2. RURAL MINOR ARTERIALS

Design Std. No's. 4 thru 9

3. RURAL COLLECTORS

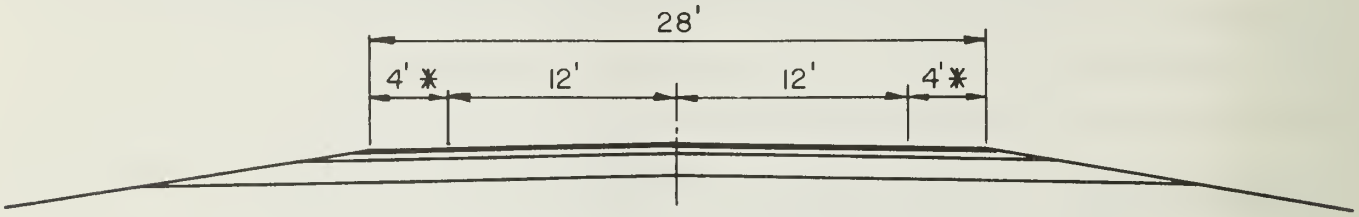
Design Std. No's. 10, 11 & 12



DESIGN STD. NO.	TERRAIN	SURFACE TYPE	SHOULDERS
4	Flat	High	10' Stabilized
5	Rolling	High	10' Stabilized
6	Mountainous	High	8' Stabilized
7	Flat	Intermediate	8' Stabilized
8	Rolling	Intermediate	8' Stabilized
9	Mountainous	Intermediate	6' Stabilized
10	Flat	High	8' Stabilized
11	Rolling	High	8' Stabilized
12	Mountainous	High	6' Stabilized

RELATIONSHIP OF DEVELOPMENT DATA TO DESIGN STANDARDS – II

TYPICAL FEDERAL AID SECONDARY DESIGN STANDARD

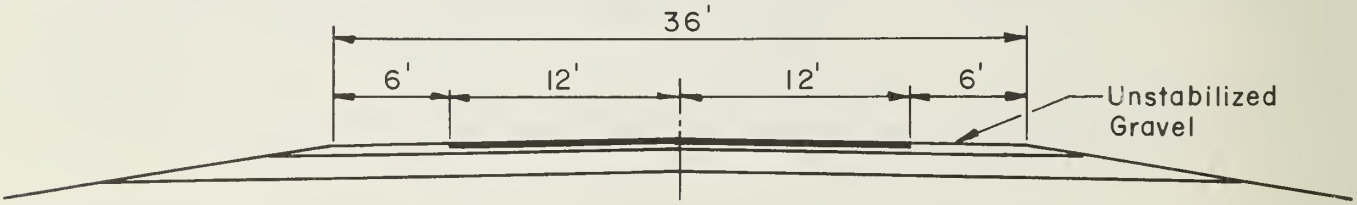


* Variable from 1' to 6'; 4' is average used on 1968 - 1969 projects
Shoulders were always paved

COMPARABLE FUNCTIONAL CLASSIFICATION DESIGN STANDARDS

1. RURAL COLLECTORS

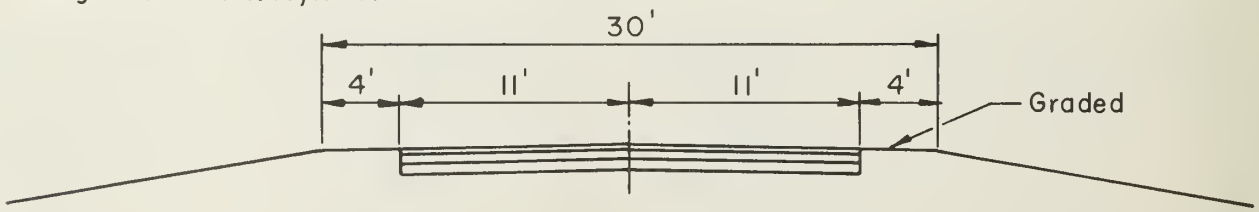
Design Std. No's. 13, 14 & 15



DESIGN STD. NO.	TERRAIN	SURFACE TYPE	SHOULDERS
13	Flat	Intermediate	6' Unstabilized
14	Rolling	Intermediate	6' Unstabilized
15	Mountainous	Intermediate	6' Unstabilized

2. RURAL COLLECTORS

Design Std. No's. 16, 17 & 18

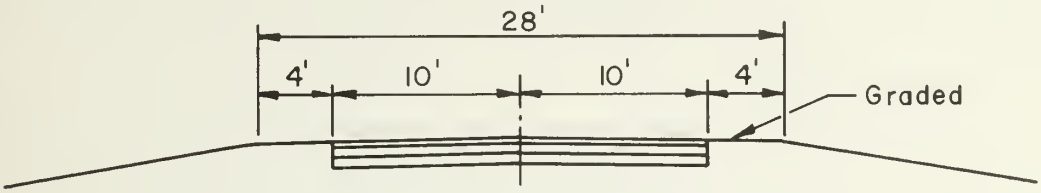


DESIGN STD. NO.	TERRAIN	SURFACE TYPE	SHOULDERS
16	Flat	Low	Graded
17	Rolling	Low	Graded
18	Mountainous	Low	Graded

RELATIONSHIP OF DEVELOPMENT DATA TO DESIGN STANDARDS - II

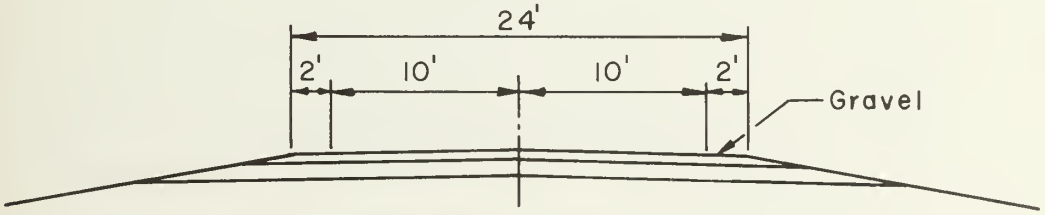
3. RURAL COLLECTORS
Design Std. No's. 19, 20 & 21

4. RURAL LOCAL ROADS
Design No's. 34 thru 39



DESIGN STD. NO.	TERRAIN	SURFACE TYPE	SHOULDERS
19	Flat	Low	Graded
20	Rolling	Low	Graded
21	Mountainous	Low	Graded
34	Flat	Low	Graded
35	Rolling	Low	Graded
36	Mountainous	Low	Graded
37	Flat	Low	Graded
38	Rolling	Low	Graded
39	Mountainous	Low	Graded

5. RURAL LOCAL ROADS
Design Std. No's. 31, 32 & 33



DESIGN STD. NO.	TERRAIN	SURFACE TYPE	SHOULDERS
31	Flat	Gravel	Gravel
32	Rolling	Gravel	Gravel
33	Mountainous	Gravel	Gravel

The paving design for the sections shown in Figures No. 21 and 22 is explained in the discussion on base and surfacing costs. It should be noted, however, that the paving costs for those sections having stabilized gravel, unstabilized gravel, or graded shoulders will be somewhat lower than they actually would be if the improvements were made according to present paving practices within the State. This is due to the fact that, in Montana, the shoulders on all paved roads carry the same paving section as the driving lanes.

A somewhat different approach was required to relate the available data to the urban design standards. Since all the urban design standards are basically the same except for pavement design, they were related to urban construction projects (F.A.P. and F.A.S. combined) on a two-lane, four-lane basis for the functional classifications higher than urban local streets. Since the design standards for urban local streets corresponded very closely with the available S.I.D. projects, the two are correlated for estimating purposes.

C. Development of Average Costs Per Mile

(1) Base and Surfacing

Because the typical section dimensions of each design standard are defined, the average costs per mile for base and surfacing are most accurately determined by computing the actual quantities required, and developing a set of average unit prices for the materials involved.

(a) Quantities Per Mile

In order to calculate the quantities per mile, it was necessary to develop three pavement designs that would correspond to high, intermediate, and low-type surfacing. This was accomplished through a study of pavement designs employed on various projects within the State during the past three years. The resulting average pavement designs are:

(1) High-Type Surfacing

0.25 ft. Plant Mix Bituminous Surfacing
0.25 ft. Compacted Crushed Top Surfacing
1.50 ft. Compacted Crushed Base Course

(2) Intermediate-Type Surfacing

0.20 ft. Plant Mix Bituminous Surfacing
0.20 ft. Compacted Crushed Top Surfacing
1.00 ft. Compacted Crushed Base Course

(3) Low-Type Surfacing

0.08 ft. Bituminous Penetration Surfacing

0.20 ft. Compacted Crushed Top Surfacing

0.50 ft. Compacted Crushed Base Course

0.50 ft. Compacted Selected Surfacing

(4) Gravel Surfacing

0.50 ft. Compacted Crushed Top Surfacing

0.70 ft. Compacted Selected Surfacing

These sections were approved as being representative of pavement thicknesses and materials currently being employed throughout the State. Using these sections, the base and surfacing quantities per mile were computed for each of the 44 design standards.

(b) Average Unit Prices

It now remained to develop average unit prices for the various base and surfacing materials used in the three pavement designs.

These prices were developed as a function of cost area, road system classification, and terrain type. In order to determine more accurately the effect of these factors on paving costs, the unit prices of 21 surfacing materials were examined rather than just those used in the surfacing designs mentioned earlier.

The cost differential for cost areas had previously been established in the cost area analysis. The same procedure was employed to determine the effect of the other two factors. By comparing the average unit prices on interstate, primary, and secondary projects to a set of base average prices (all projects combined), it was possible to determine how prices varied according to the magnitude of a project. By classifying the projects according to terrain type and comparing the average unit prices for each group to the base average prices, the desired effect of terrain on costs was obtained. In index form, the cost differentials determined by comparing the group average unit prices are as follows. In all cases, the base index 1.000 is based on the average unit prices for all projects combined.

(1) Cost Area Indices

Cost Area One 1.0908

Cost Area Two 0.9156

(2) **Road System Indices**

Interstate 0.9281

Primary 1.0397

Secondary 1.3276

(3) **Terrain-Type Indices**

Flat 0.8794

Rolling 1.1081

Mountainous 1.1106

It was then necessary to combine the foregoing indices to obtain the combined effect of the three factors shown to influence costs. This was accomplished by taking the algebraic sum of the individual deviations from the base index 1.000 for each of the 18 combinations produced by the three factors. The indices, representing the combined effect of cost area, project, classification, and terrain type on surfacing prices, are shown in the following table.

RURAL BASE AND SURFACING COST INDICES

	Cost Area One			Cost Area Two		
	F	R	M	F	R	M
Interstate	0.8983	1.1270	1.1295	0.7231	0.9518	0.9543
Primary	1.0099	1.2386	1.2411	0.8347	1.0634	1.0659
Secondary	1.2978	1.5265	1.5290	1.1226	1.3513	1.3538

By multiplying the state-wide average unit prices by these indices, 18 sets of prices were obtained for use with the quantities for any of the rural design standards. Thus, the desired cost per mile for base and surfacing for each rural design standard was obtained.

The urban base and surfacing costs were developed in the same manner as the rural costs, except that the average unit prices were developed from strictly urban projects. All of the available urban projects were classified according to urbanized area with all other urban projects being grouped together as 'small urban'. The average unit prices for each group of projects were computed and indexed to the average unit prices from all projects combined. These indices are shown in the following table.

URBAN BASE AND SURFACING COST INDICES	
1. Great Falls	0.9961
2. Billings	0.9775
3. Missoula	1.0054
4. Small Urban	1.0064

Four sets of average unit prices were obtained by multiplying the average unit prices for all urban projects combined by these indices. The cost per mile for base and surfacing for each urban design standard was obtained by applying the average unit prices to the quantities developed for each design standard.

The urban quantities were computed using surfacing designs developed by averaging urban surfacing designs used within the State in recent years. The surfacing designs used to compute the quantities per mile are:

(1) High-Type Surfacing

0.25 ft. Plant Mix Bituminous Surfacing

0.25 ft. Compacted Crushed Top Surfacing

1.50 ft. Compacted Crushed Base Course

(2) Intermediate-Type Surfacing

0.20 ft. Plant Mix Bituminous Surfacing

0.20 ft. Compacted Crushed Top Surfacing

1.10 ft. Compacted Crushed Base Course

(3) Low-Type Surfacing

0.08 ft. Bituminous Penetration Surfacing

0.20 ft. Compacted Crushed Top Surfacing

0.50 ft. Compacted Crushed Base Course

0.50 ft. Compacted Selected Surfacing

(2) Grading and Drainage Costs

The costs per mile for grading and drainage were obtained by computing the average total cost of grade and drain items from the detail estimates of projects constructed within the State in 1968 and 1969. The average costs per mile were computed from 76 projects representing $40,665,500 in grading and drainage costs.

Because the estimated cost for needed improvements are based on 1969 prices, the costs taken from projects let in 1968 had to be indexed to the 1969 cost level. Using the Montana Highway Commission's *Tabulation of Low Bid Prices and Computation of Average Prices* for the two twelve-month periods ending December 31, 1968 and December 31, 1969, a comparison was made between all the grading and drainage items listed therein. Based on 18 bid items, the 1969 grading costs were 13.30 percent higher than they were in 1968. Based on 61 items, the 1969 drainage costs were 10.67 percent higher than they were in 1968. The costs taken from projects let in 1968 were adjusted accordingly and used with those let in 1969 to develop the desired costs per mile for grading and drainage.

The projects used to develop the rural average costs per mile for grading and drainage were classified by cost area, road system, and terrain type. The average cost per mile from each group of projects was computed and assigned to rural design standards as previously shown in Figures No. 21 and 22.

The grading and drainage costs for urban design standards were developed by grouping the urban projects according to the urban classifications and computing the average cost per mile for two and four-lane construction. Curbs, gutters, and sidewalks were considered as part of the urban typical sections and their respective costs were included in the costs per mile for base and surfacing. The detail estimates were carefully examined to extract only the costs associated with grading and drainage.

(3) 'Other' Costs

This group of average costs per mile is intended to include the cost for all construction items other than base and surfacing, and grading and drainage. Included are items such as signing, lighting, striping, erosion control, beautification, fencing, and roadside development. The total cost for these items was taken from the detail estimates of the same 76 projects used to develop the grading and drainage costs.

The rural projects were grouped as previously explained and their respective average costs per mile were computed to apply to the rural design standards as previously shown in Figures No. 21 and 22.

The urban 'other' costs were computed in the same manner as a function of urban classification and number of lanes.

(4) Structure Costs

A comprehensive schedule of average costs per square foot for bridge structures was

prepared by the Highway Commission's Bridge Division. These costs were developed as a function of loading and type of construction. For use in the needs appraisal, an average cost was computed from this schedule based on all type structures built within the State in recent years. For the most part, the costs used are representative of prestressed beam construction and H20 loading, and comply with the design standards.

The average costs per square foot developed from the schedule provided by the Bridge Division are shown in the following table.

AVERAGE STRUCTURE COSTS

Urban and Rural

Bridge over highway or stream	
(Prestressed concrete beams)	$12.50 per sq. ft.
Bridge over minor river	
(Simple welded plate girder)	$16.50 per sq. ft.
Bridge over major river	
(Continuous weld plate girder)	$23.00 per sq. ft.

(5) Right-of-Way Costs

Two steps were used in developing the estimated costs for right-of-way and utility adjustments. The first involved determining the average cost per acre for acquisition, access rights, legal fees, relocation costs, engineering, etc. These costs were developed by the Highway Commission's Right-of-Way Division.

The second step involved determining the amount of right-of-way required for the various improvements. Average existing right-of-way widths on the various road systems were obtained from the Right-of-Way Division, and the desirable right-of-way corridor was computed based on current practices and recommendations pertaining to slopes and recovery areas from the 1967 AASHO *Yellow Book* (Highway Design and Operational Practices Related to Highway Safety). The rural right-of-way corridors were based on F.A.I., F.A.P., and F.A.S. standards and related to the design standards in the same manner as the construction costs. The rural right-of-way corridors used to develop the average costs per mile are shown in the following table.

ESTIMATED BASIC RIGHT–OF–WAY CORRIDORS	
Interstate-Type Construction	
For all four-lane principal and minor arterials	
Average existing R/W before improvement	130 ft.
Desirable R/W with improvement	288 ft.
Primary-Type Construction	
For two-lane rural principal and minor arterials	
Average existing R/W before improvement	100 ft.
Desirable R/W with improvement	160 ft.
Secondary-Type Construction	
For two-lane rural minor arterials, collectors, and local roads	
Average existing R/W before improvement	60 ft.
Desirable R/W with improvement	130 ft.

The following terrain factors were applied to allow for construction limits outside of the basic right-of-way corridors.

(a) Flat Terrain 1.000

(b) Rolling Terrain 1.075

(c) Mountainous Terrain 1.150

Consideration was given to access control as related to the design standards in the development of the unit per acre costs. Separate unit costs were developed for right-of-way requiring full, partial, and no access control.

In urban areas, the existing right-of-way was usually sufficient for the required improvements. For those study sections requiring new or additional right-of-way, the cost was computed individually for each section based on unit prices supplied by the Right-of-Way Division.

(6) Preliminary and Construction Engineering

From records provided by the State Highway Commission's Accounting Division, costs for preliminary and construction engineering were developed as a percentage of the construction costs. These percentages were computed for each of the roadway classifications and added to the per-mile construction costs according to the comparable design standards. A separate engineering factor was computed for urban improvements. The percentages to be added to the per-mile construction costs are as follows:

(a) Interstate-Type Construction 18.12%

(b) Primary-Type Construction 20.35%

(c) Secondary-Type Construction 24.86%

(d) Urban-Type Construction 13.68%

(e) Local Roads and Streets 10.00%

D. Type of Improvement

(1) New Location

The grading and drainage and 'other' costs developed from interstate projects were considered to be representative of costs required for improvements calling for complete construction on a new alignment. These costs were applied directly to four-lane principal and minor arterials. The costs developed from primary and secondary projects were considered to be representative of reconstruction on the present alignment. The new location costs were prorated from these costs for all two-lane design standards. An examination of the difference between new location and reconstruction requirements was made and the following factors determined as a function of the type of terrain.

(a) Flat Terrain

New Location = Reconstruction + 10%

(b) Rolling Terrain

New Location = Reconstruction + 20%

(c) Mountainous Terrain

New Location = Reconstruction + 30%

The costs developed directly from urban projects were considered to be applicable for both new location and reconstruction type improvements; the only difference being in the right-of-way costs.

In all cases, the base and surfacing costs were developed from the actual quantities required for the improvement.

(2) Reconstruction

The grading and drainage and 'other' costs developed from rural primary and secondary projects were considered to be representative of the costs required for reconstruction type improvements. To obtain costs for reconstruction of four-lane roadways, the costs developed from interstate projects were factored **down** by the same factors explained in *1. New Location.*

The reconstruction costs for urban design standards are those developed directly from the urban projects.

The base and surfacing costs were developed from the actual quantities required.

(3) Isolated Reconstruction

Isolated reconstruction is defined as reconstruction of less than 40 percent of any particular study section. The amount of reconstruction required was determined in the deficiency analysis and the cost of the improvement was taken from the reconstruction costs.

(4) Major Widening

Major widening is defined as the addition of lanes to an existing facility. The cost of major widening was developed from the new construction costs for the additional lanes plus the cost to widen and resurface the existing lanes.

(5) Minor Widening

The minor widening costs were prorated from the reconstruction costs on a per-foot of widening basis. Base and surfacing costs were computed from the actual quantities, and included resurfacing of the existing roadway.

(6) Resurfacing

The base and surfacing costs were computed from the actual quantities required to resurface the existing facility. Four percent of the base and surfacing costs was added to allow for reshaping or improving the shoulders. Six percent was added for 'other costs'.

E. Tables of Average Costs Per Mile

The tables which follow show the per-mile costs developed in this section.

RURAL CONSTRUCTION COST SUMMARY NO. 1

ROADWAY DESIGN DESCRIPTION						COST AREA ONE												COST AREA TWO											
						NEW LOCATION				RECONSTRUCTION				RESURFACING				NEW LOCATION				RECONSTRUCTION				RESURFACING			
FUNCTIONAL CLASSIFICATION	D.S.N.	TERRAIN	LANES	PROJ. EQ.	% ENGR.	GR. & DR.	B & SURF.	OTHER	TOTAL	GR. & DR.	B & SURF.	OTHER	TOTAL	GR. & DR.	B & SURF.	OTHER	TOTAL	GR. & DR.	B & SURF.	OTHER	TOTAL	GR. & DR.	B & SURF.	OTHER	TOTAL	GR. & DR.	B & SURF.	OTHER	TOTAL
PRINCIPAL ARTERIALS	1	FLAT	2	F.A.P.	20.35%	98,326	92,148	44,019	234,493	89,388	92,148	40,018	221,554	1,257	30,663	1,840	33,730	85,284	76,297	30,397	191,978	77,531	76,297	27,634	181,462	1,013	25,320	1,519	27,852
	1	FLAT	4	F.A.I.	18.12%	204,296	137,279	52,430	394,005	185,725	137,279	47,664	370,668	1,784	44,591	2,675	49,050	160,233	110,824	40,645	311,702	145,667	110,824	36,950	293,441	1,438	35,940	2,156	39,534
	2	ROLLING	2	F.A.P.	20.35%	138,085	105,015	52,172	295,272	115,070	105,015	43,476	263,561	1,379	34,477	2,069	37,925	126,742	90,276	36,533	253,551	105,618	90,276	30,445	226,339	1,184	29,596	1,776	32,556
	2	ROLLING	4	F.A.I.	18.12%	362,245	165,051	59,297	586,593	301,871	165,051	49,414	516,336	2,124	53,104	3,186	58,414	332,719	139,682	43,869	516,270	277,267	139,682	36,557	453,506	1,796	44,888	2,693	49,377
	3	MOUNTAINOUS	2	F.A.P.	20.35%	192,863	97,125	82,547	372,535	148,357	97,125	63,498	308,980	1,250	31,405	1,884	34,545	176,022	83,000	52,331	312,019	135,401	83,666	40,255	259,322	1,079	26,972	1,618	29,669
	3	MOUNTAINOUS	4	F.A.I.	18.12%	453,549	200,708	98,440	752,757	348,884	200,708	71,107	620,759	2,241	56,021	3,362	61,628	444,347	174,408	71,629	690,384	341,806	174,408	55,099	571,313	1,895	47,376	2,843	52,114
MINOR ARTERIALS	4	FLAT	2	F.A.I.	20.35%	98,326	74,976	44,019	217,321	89,388	74,976	40,018	204,382	789	19,733	1,184	21,706	85,284	62,116	30,397	177,797	77,531	62,116	27,634	167,281	652	16,306	978	17,936
	4	FLAT	4	F.A.I.	18.12%	204,296	118,137	52,430	374,863	185,725	118,137	47,664	351,526	1,286	32,139	1,928	35,353	160,233	95,396	40,645	296,274	145,667	95,396	36,950	278,013	1,036	25,908	1,554	28,498
	5	ROLLING	2	F.A.P.	20.35%	138,085	92,022	52,172	282,279	115,070	92,022	43,476	250,568	969	24,223	1,453	26,645	126,742	79,105	36,533	242,380	105,618	79,105	30,445	215,168	831	20,782	1,247	22,860
	5	ROLLING	4	F.A.I.	18.12%	362,245	148,223	59,297	569,765	301,871	148,223	49,414	499,508	1,612	40,293	2,418	44,323	332,719	125,465	43,869	502,053	277,267	125,465	36,557	439,289	1,362	34,061	2,044	37,467
	6	MOUNTAINOUS	2	F.A.P.	20.35%	192,863	86,496	82,547	361,906	148,357	86,496	63,498	298,351	927	23,182	1,391	25,500	176,022	74,432	52,331	302,785	135,401	74,432	40,255	250,088	797	19,914	1,195	21,906
	6	MOUNTAINOUS	4	F.A.I.	18.12%	453,549	197,345	92,440	743,334	348,884	197,345	71,107	617,336	1,948	48,699	2,922	53,569	444,347	166,425	71,629	682,401	341,806	166,425	55,099	563,330	1,647	41,168	2,470	45,285
	7	FLAT	2	F.A.P.	20.35%	98,326	56,901	44,019	199,246	89,388	56,901	40,018	186,307	754	18,853	1,131	20,737	85,284	47,277	30,397	162,958	77,531	47,277	27,634	152,442	623	15,577	935	17,135
	8	ROLLING	2	F.A.P.	20.35%	138,085	70,631	52,172	260,888	115,070	70,631	43,476	229,177	926	23,140	1,388	25,454	126,742	60,031	36,533	223,306	105,618	60,031	30,445	196,094	794	19,855	1,191	21,840
	9	MOUNTAINOUS	2	F.A.P.	20.35%	192,863	65,139	82,547	340,549	148,357	65,139	63,498	276,994	884	22,097	1,326	24,307	176,022	56,048	52,331	284,401	135,401	56,048	40,255	231,704	759	18,980	1,139	20,878
COLLECTORS	10	FLAT	2	F.A.P.	20.35%	98,326	70,419	44,019	212,764	89,388	70,419	40,018	199,825	754	18,853	1,131	20,737	85,284	58,931	30,397	174,612	77,531	58,931	27,634	164,096	623	15,577	935	17,135
	11	ROLLING	2	F.A.P.	20.35%	138,085	86,426	52,172	276,683	115,070	86,426	43,476	244,972	926	23,140	1,388	25,454	126,742	74,296	36,533	237,571	105,618	74,296	30,445	210,359	794	19,855	1,191	21,840
	12	MOUNTAINOUS	2	F.A.P.	20.35%	192,863	80,441	82,547	355,851	148,357	80,441	63,497	292,295	884	22,097	1,326	24,307	176,022	69,221	52,331	297,574	135,401	69,221	40,255	244,877	759	18,980	1,139	20,678
	13	FLAT	2	F.A.S.	24.86%	38,910	69,284	11,191	119,385	35,373	69,284	10,174	114,831	909	22,730	1,364	25,003	41,264	60,038	10,965	112,267	37,513	60,038	9,969	107,520	786	19,662	1,180	21,628
	14	ROLLING	2	F.A.S.	24.86%	63,520	81,481	13,115	158,116	52,933	81,481	10,929	145,343	1,069	26,716	1,603	29,388	49,648	72,654	13,660	135,562	41,374	72,654	11,383	125,011	947	23,668	1,420	26,035
	15	MOUNTAINOUS	2	F.A.S.	24.86%	142,255	61,831	16,920	241,006	109,427	81,831	13,015	204,273	1,071	26,769	1,606	29,446	68,949	72,306	16,290	157,545	53,038	72,306	12,531	137,875	948	23,710	1,423	26,081
	16	FLAT	2	F.A.S.	24.86%	38,910	30,718	11,191	80,819	35,373	30,718	10,174	76,265	749	18,734	1,124	20,607	41,264	26,518	10,965	78,747	37,513	26,518	9,969	74,000	648	16,203	972	17,823
	17	ROLLING	2	F.A.S.	24.86%	63,520	36,074	13,115	112,713	52,933	36,078	10,929	99,940	881	22,022	1,321	24,224	49,648	31,936	13,660	95,246	41,374	31,938	11,383	84,695	780	19,507	1,170	21,457
	18	MOUNTAINOUS	2	F.A.S.	24.86%	142,255	36,172	16,920	195,347	109,427	36,172	13,015	158,614	882	22,060	1,324	24,266	68,949	32,113	16,290	117,352	53,038	32,113	12,531	97,682	782	19,544	1,173	21,499
	19	FLAT	2	F.A.S.	24.86%	38,910	27,237	11,191	77,338	35,373	27,237	10,174	72,784	681	17,031	1,022	18,734	41,264	24,142	10,965	76,371	37,513	24,142	9,969	71,624	589	14,730	884	16,203
	20	ROLLING	2	F.A.S.	24.86%	63,520	32,829	13,115	109,514	52,933	32,879	10,929	96,741	801	20,020	1,201	22,022	49,648	29,106	13,660	92,414	41,374	29,106	11,383	81,863	709	17,735	1,064	19,508
	21	MOUNTAINOUS	2	F.A.S.	24.86%	142,255	32,964	16,920	192,139	109,427	32,964	13,015	155,406	802	20,053	1,203	22,058	68,949	29,266	16,290	114,505	53,038	29,266	12,531	94,835	711	17,769	1,066	19,546

RURAL CONSTRUCTION COST SUMMARY NO. 2

MAJOR WIDENING

ROADWAY DESIGN DESCRIPTION						COST AREA ONE			COST AREA TWO		
FUNCTIONAL CLASSIFICATION	D.S.N.	TERRAIN	LANES	PROJ. EQ	% ENGR	GRADE & DRAIN	BASE & SURFACE	OTHER	GRADE & DRAIN	BASE & SURFACE	OTHER
PRINCAL ARTERIALS	1	FLAT	4	F.A.I.	18.12%	$102,148 + W($2,483)	$ 95,709 + W($ 724)	$ 47,664	$ 80,117 + W($2,154)	$ 77,234 + W($ 584)	$ 36,950
	2	ROLLING	4	F.A.I.	18.12%	$181,123 + W($3,196)	$115,004 + W($ 908)	$ 49,414	$166,360 + W($2,934)	$ 97,300 + W($ 770)	$ 36,557
	3	MOUNTAINOUS	4	F.A.I.	18.12%	$ 348,884	$ 206,768	$ 71,107	$ 341,806	$ 174,408	$ 55,099
MINOR ARTERIALS	4	FLAT	4	F.A.I.	18.12%	$102,148 + W($2,483)	$ 70,824 + W($ 914)	$ 47,664	$ 80,117 + W($2,154)	$ 57,172 + W($ 737)	$ 36,950
	5	ROLLING	4	F.A.I.	18.12%	$181,123 + W($3,196)	$ 88,838 + W($1,146)	$ 49,414	$166,360 + W($2,934)	$ 75,188 + W($ 971)	$ 36,557
	6	MOUNTAINOUS	4	F.A.I.	18.12%	$ 348,884	$ 197,345	$ 71,107	$ 341,806	$ 166,425	$ 55,099

MINOR WIDENING

ROADWAY DESIGN DESCRIPTION						COST AREA ONE			COST AREA TWO		
FUNCTIONAL CLASSIFICATION	D.S.N.	TERRAIN	LANES	PROJ. EQ.	% ENGR.	GRADE & DRAIN	BASE & SURFACE	OTHER	GRADE & DRAIN	BASE & SURFACE	OTHER
PRINCIPAL ARTERIALS	1	FLAT	2	F.A.P.	20.35%	W($ 3,228)	$ 38,604 + W($ 792)	W($ 1,112)	W($ 2,800)	$ 31,878 + W($ 657)	W($ 768)
	2	ROLLING	2	F.A.P.	20.35%	W($ 4,155)	$ 43,587 + W($ 972)	W($ 1,208)	W($ 3,814)	$ 37,422 + W($ 836)	W($ 846)
	3	MOUNTAINOUS	2	F.A.P.	20.35%	W($ 5,357)	$ 39,953 + W($ 972)	W($ 1,764)	W($ 4,889)	$ 34,314 + W($ 837)	W($ 1,118)
MINOR ARTERIALS	4	FLAT	2	F.A.P.	20.35%	W($ 3,228)	$ 18,275 + W($ 1,018)	W($ 1,112)	W($ 2,800)	$ 15,095 + W($ 845)	W($ 768)
	5	ROLLING	2	F.A.P.	20.35%	W($ 4,155)	$ 22,425 + W($ 1,251)	W($ 1,208)	W($ 3,814)	$ 19,243 + W($ 1,075)	W($ 846)
	6	MOUNTAINOUS	2	F.A.P.	20.35%	W($ 5,357)	$ 22,470 + W($ 1,251)	W($ 1,764)	W($ 4,889)	$ 19,289 + W($ 1,077)	W($ 1,118)
	7	FLAT	2	F.A.P.	20.35%	W($ 3,228)	$ 14,559 + W($ 882)	W($ 1,112)	W($ 2,800)	$ 12,163 + W($ 732)	W($ 768)
	8	ROLLING	2	F.A.P.	20.35%	W($ 4,155)	$ 17,858 + W($ 1,084)	W($ 1,208)	W($ 3,814)	$ 15,331 + W($ 931)	W($ 846)
	9	MOUNTAINOUS	2	F.A.P.	20.35%	W($ 5,357)	$ 17,895 + W($ 1,084)	W($ 1,764)	W($ 4,889)	$ 15,368 + W($ 933)	W($ 1,118)
COLLECTORS	10	FLAT	2	F.A.P.	20.35%	W($ 3,228)	$ 18,275 + W($ 1,018)	W($ 1,112)	W($ 2,800)	$ 15,095 + W($ 845)	W($ 768)
	11	ROLLING	2	F.A.P.	20.35%	W($ 4,155)	$ 22,425 + W($ 1,251)	W($ 1,208)	W($ 3,814)	$ 19,243 + W($ 1,075)	W($ 846)
	12	MOUNTAINOUS	2	F.A.P.	20.35%	W($ 5,357)	$ 22,470 + W($ 1,251)	W($ 1,764)	W($ 4,889)	$ 19,289 + W($ 1,077)	W($ 1,118)
	13	FLAT	2	F.A.S.	24.86%	W($ 1,642)	$ 19,409 + W($ 1,073)	W($ 363)	W($ 1,742)	$ 16,786 + W($ 930)	W($ 356)
	14	ROLLING	2	F.A.S.	24.86%	W($ 2,457)	$ 22,814 + W($ 1,262)	W($ 390)	W($ 1,921)	$ 20,210 + W($ 1,119)	W($ 407)
	15	MOUNTAINOUS	2	F.A.S.	24.86%	W($ 5,080)	$ 22,853 + W($ 1,269)	W($ 465)	W($ 2,462)	$ 20,248 + W($ 1,119)	W $ 448)

RURAL RIGHT-OF-WAY COST SUMMARY NO. 1

RURAL DEVELOPMENT

ROADWAY DESIGN DESCRIPTION				NEW LOCATION									RECONSTRUCTION									WIDENING								
				FULL ACCESS CONTROL			PARTIAL ACCESS CONTROL			NO ACCESS CONTROL			FULL ACCESS CONTROL			PARTIAL ACCESS CONTROL			NO ACCESS CONTROL			FULL ACCESS CONTROL			PARTIAL ACCESS CONTROL			NO ACCESS CONTROL		
FUNCTIONAL CLASSIFICATION	D.S.N	LANES	TERRAIN	A/MILE	$/ACRE	$/MILE	A/MILE	$/ACRE	$/MILE	A/MILE	$/ACRE	$/MILE	A/MILE	$/ACRE	$/MILE	A/MILE	$/ACRE	$/MILE	A/MILE	$/ACRE	$/MILE	A/MILE	$/ACRE	$/MILE	A/MILE	$/ACRE	$/MILE	A/MILE	$/ACRE	$/MILE
PRINCIPAL ARTERIALS	1	2	F	19.39	1,000	19,390	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	7.27	1,100	7,997	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	7.27	1,000	7,270	7.27	800	5,816	N.A.	N.A.	N.A.
	1	4	F	34.91	1,000	34,910							19.15	1,100	21,065							19.15	1,000	19,150	19.15	800	15,320			
	2	2	R	20.75	850	17,638							8.63	950	8,199							8.63	850	7,336	8.63	650	5,610			
	2	4	R	37.35	850	31,748							21.59	950	20,511							21.59	850	18,352	21.59	650	14,034			
	3	2	M	22.30	600	13,380							10.18	700	7,126							10.18	600	6,108	10.18	450	4,581			
	3	4	M	31.03	600	18,618							15.27	700	10,689							15.27	600	9,162	15.27	450	6,872			
MINOR ARTERIALS	4	2	F	19.39	800	15,512	19.39	650	12,604	N.A.	N.A.	N.A.	7.27	900	6,543	7.27	700	5,089	7.27	600	4,362	N.A.	N.A.	N.A.	7.27	600	4,362	7.27	550	3,999
	4	4	F	34.91	800	27,928	34.91	650	22,692				19.15	900	17,235	19.15	700	13,405	19.15	600	11,490				19.15	600	11,490	19.15	550	10,533
	5	2	R	20.75	700	14,525	20.75	550	11,413				8.63	800	6,904	8.63	650	5,610	8.63	550	4,747				8.63	500	4,315	8.63	450	3,884
	5	4	R	37.35	700	26,145	37.35	550	20,543				21.59	800	17,272	21.59	650	14,034	21.59	550	11,875				21.59	500	10,795	21.59	450	9,716
	6	2	M	22.30	600	13,380	22.30	450	10,035				10.18	700	7,126	10.18	550	5,599	10.18	500	5,090				10.18	400	4,072	10.18	300	3,054
	6	4	M	31.03	600	18,618	31.03	450	13,964				15.27	700	10,689	15.27	550	8,399	15.27	500	7,635				15.27	400	6,108	15.27	300	4,581
	7	2	F	19.39	800	15,512	19.39	650	12,604				7.27	900	6,543	7.27	700	5,089	7.27	600	4,362				7.27	600	4,362	7.27	550	3,999
	8	2	R	20.75	700	14,525	20.75	550	11,413				8.63	800	6,904	8.63	650	5,610	8.63	550	4,747				8.63	500	4,315	8.63	450	3,884
	9	2	M	22.30	600	13,380	22.30	450	10,035				10.18	700	7,126	10.18	550	5,599	10.18	500	5,090				10.18	400	4,072	10.18	300	3,054
COLLECTORS	10	2	F	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	19.39	600	11,634	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	7.27	400	2,908	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	7.27	400	2,908
	11	2	R							20.75	500	10,375							8.63	300	2,589							8.63	300	2,589
	12	2	M							22.30	400	8,920							10.18	200	2,036							10.18	200	2,036
	13	2	F							15.76	600	9,456							8.49	400	3,396							8.49	400	3,396
	14	2	R							16.86	500	8,430							9.59	300	2,877							9.59	300	2,877
	15	2	M							18.12	400	7,246							10.85	200	2,170							10.85	200	2,170
	16	2	F							15.76	600	9,456							8.49	400	3,396							8.49	400	3,396
	17	2	R							16.86	500	8,430							9.59	300	2,877							9.59	300	2,877
	18	2	M							18.12	400	7,248							10.85	200	2,170							10.85	200	2,170
	19	2	F							15.76	600	9,456							8.49	400	3,396							8.49	400	3,396
	20	2	R							16.86	500	8,430							9.59	300	2,877							9.59	300	2,877
	21	2	M							18.12	400	7,248							10.85	200	2,170							10.85	200	2,170

RURAL RIGHT-OF-WAY COST SUMMARY NO. 2

DENSE DEVELOPMENT

ROADWAY DESIGN DESCRIPTION				NEW LOCATION									RECONSTRUCTION									WIDENING								
				FULL ACCESS CONTROL			PARTIAL ACCESS CONTROL			NO ACCESS CONTROL			FULL ACCESS CONTROL			PARTIAL ACCESS CONTROL			NO ACCESS CONTROL			FULL ACCESS CONTROL			PARTIAL ACCESS CONTROL			NO ACCESS CONTROL		
FUNCTIONAL CLASSIFICATION	D.S.N	LANES	TERRAIN	A/MILE	$/ACRE	$/MILE	A/MILE	$/ACRE	$/MILE	A/MILE	$/ACRE	$/MILE	A/MILE	$/ACRE	$/MILE	A/MILE	$/ACRE	$/MILE	A/MILE	$/ACRE	$/MILE	A/MILE	$/ACRE	$/MILE	A/MILE	$/ACRE	$/MILE	A/MILE	$/ACRE	$/MILE
PRINCIPAL ARTERIALS	1	2	F	7.27	2,000	14,540								2,500									2,000			1,600				
	1	4	F	12.12	2,000	24,240								2,500									2,000			1,600				
	2	2	R	7.27	1,700	12,359								2,200									1,800			1,200				
	2	4	R	12.12	1,700	20,604								2,200									1,800			1,200				
	3	2	M	7.27	1,300	9,451								1,800									1,600			1,000				
	3	4	M	12.12	1,300	15,756								1,800									1,600			1,000				
MINOR ARTERIALS	4	2	F	7.27	2,000	14,540	7.27	1,600	11,632					2,500			2,000			1,750						2,000			1,400	
	4	4	F	12.12	2,000	24,240	12.12	1,600	19,392					2,500			2,000			1,750						2,000			1,400	
	5	2	R	7.27	1,700	12,359	7.27	1,350	9,815					2,200			1,800			1,500						1,200			1,100	
	5	4	R	12.12	1,700	20,604	12.12	1,350	16,362					2,200			1,800			1,500						1,200			1,100	
	6	2	M	7.27	1,300	9,451	7.27	1,050	7,634					1,800			1,400			1,300						1,000			900	
	6	4	M	12.12	1,300	15,756	12.12	1,050	12,726					1,800			1,400			1,300						1,000			900	
	7	2	F	7.27	2,000	14,540	7.27	1,600	11,632					2,500			2,000			1,750						2,000			1,400	
	8	2	R	7.27	1,700	12,359	7.27	1,350	9,815					2,200			1,800			1,500						1,200			1,100	
	9	2	M	7.27	1,300	9,451	7.27	1,050	7,634					1,800			1,400			1,300						1,000			900	
COLLECTORS	10	2	F							7.27	1,200	8,724								800									800	
	11	2	R							7.27	1,000	7,270								800									800	
	12	2	M							7.27	700	5,089								800									800	
	13	2	F							7.27	1,200	8,724								800									800	
	14	2	R							7.27	1,000	7,270								800									800	
	15	2	M							7.27	700	5,089								800									800	
	16	2	F							7.27	1,200	8,724								800									800	
	17	2	R							7.27	1,000	7,270								800									800	
	18	2	M							7.27	700	5,089								800									800	
	19	2	F							7.27	1,200	8,724								800									800	
	20	2	R							7.27	1,000	7,270								800									800	
	21	2	M							7.27	700	5,089								800									800	

URBAN CONSTRUCTION COST SUMMARY NO. 1

ROADWAY DESIGN DESCRIPTION					GREAT FALLS												BILLINGS											
					NEW LOCATION				RECONSTRUCTION				RESURFACING				NEW LOCATION				RECONSTRUCTION				RESURFACING			
FUNCTIONAL CLASSIFICATION	D.S.N	TYPE OF AREA	LANES	MEDIAN	GR & DR	B. & SURF	OTHER	TOTAL	GR & DR	B. & SURF	OTHER	TOTAL	GR & DR	B & SURF	OTHER	TOTAL	GR & DR	B & SURF	OTHER	TOTAL	GR & DR	B & SURF	OTHER	TOTAL	GR & DR	B & SURF	OTHER	TOTAL
PRINCIPAL ARTERIALS	24	BUILT UP	2		242,576	199,913	69,925	512,414	202,146	199,913	58,272	460,331	1,351	33,766	2,026	37,143	242,576	196,369	69,925	508,870	202,146	196,369	58,272	460,197	1,324	33,108	1,986	36,418
	24	BUILT UP	4	6'	245,412	336,103	171,657	753,172	204,510	336,103	143,055	683,668	2,272	56,825	3,409	62,506	245,412	330,119	171,657	747,188	204,510	330,119	143,055	677,684	2,229	55,720	3,343	61,292
	24	BUILT UP	4	16'	245,412	367,531	171,657	784,600	204,510	367,531	143,055	715,096	2,272	56,825	3,409	62,506	245,412	360,991	171,657	778,060	204,510	360,991	143,055	708,556	2,229	55,720	3,343	61,292
	24	BUILT UP	6	6'	294,488	358,049	205,988	858,524	245,412	358,049	171,657	775,118	2,536	63,414	3,805	69,755	294,488	351,679	205,988	852,155	245,412	351,679	171,657	768,748	2,487	62,182	3,731	68,400
	24	BUILT UP	6	16'	294,488	389,421	205,988	889,897	245,412	389,421	171,657	806,490	2,536	63,414	3,805	69,755	294,488	382,496	205,988	882,972	245,412	382,496	171,657	799,565	2,487	62,182	3,731	68,400
	25	OUTLYING	2		242,576	199,913	69,925	512,414	202,146	199,913	58,272	460,331	1,351	33,766	2,026	37,143	242,576	196,369	69,925	508,870	202,146	169,369	58,272	460,197	1,324	33,108	1,986	36,418
	25	OUTLYING	4	6'	245,412	336,103	171,657	753,172	204,510	336,103	143,055	683,668	2,272	56,825	3,409	62,506	245,412	330,119	171,657	747,188	204,510	330,119	143,055	677,684	2,229	55,720	3,343	61,292
	25	OUTLYING	4	16'	245,412	367,531	171,657	784,600	204,510	367,531	143,055	715,096	2,272	56,825	3,409	62,506	245,412	360,991	171,657	778,060	204,510	360,991	143,055	708,556	2,229	55,720	3,343	61,292
	25	OUTLYING	6	6'	294,488	358,049	205,988	858,525	245,412	358,049	171,657	775,118	2,536	63,414	3,805	69,755	294,488	351,679	205,988	852,155	245,412	351,679	171,657	768,748	2,487	62,182	3,731	68,400
	25	OUTLYING	6	16'	294,488	389,421	205,988	889,897	245,412	389,421	171,657	806,490	2,536	63,414	3,805	69,755	294,488	382,496	205,988	882,972	245,412	382,496	171,657	799,565	2,487	62,182	3,731	68,400
MINOR ARTERIAL STREETS	26	BUILT UP	2		242,576	199,913	69,925	512,414	202,146	199,913	58,272	460,331	1,351	33,766	2,026	37,143	242,576	196,369	69,925	508,870	202,146	196,369	58,272	460,197	1,324	33,108	1,986	36,418
	26	BUILT UP	4	6'	245,412	336,103	171,657	753,172	204,510	336,103	143,055	683,668	2,272	56,825	3,409	62,506	245,412	330,119	171,657	747,188	204,510	330,119	143,055	677,684	2,229	55,720	3,343	61,292
	26	BUILT UP	4	16'	245,412	367,531	171,657	784,600	204,510	367,531	143,055	715,096	2,272	56,825	3,409	62,506	245,412	360,991	171,657	778,060	204,510	360,991	143,055	708,556	2,229	55,720	3,343	61,292
	27	OUTLYING	2		242,576	199,913	69,925	512,414	202,146	199,913	58,272	460,331	1,351	33,766	2,026	37,143	242,576	196,369	69,925	508,870	202,146	196,369	58,272	460,197	1,324	33,108	1,986	36,418
	27	OUTLYING	4	6'	245,412	336,103	171,657	753,172	204,510	336,103	143,055	683,668	2,272	56,825	3,409	62,506	245,412	330,119	171,657	747,188	204,510	330,119	143,055	677,684	2,229	55,720	3,343	61,292
	27	OUTLYING	4	16'	245,412	367,531	171,657	784,600	204,510	367,531	143,055	715,096	2,272	56,825	3,409	62,506	245,412	360,991	171,657	778,060	204,510	360,991	143,055	708,556	2,229	55,720	3,343	61,292
COLLECTOR STREETS	28	COMM. & INDUST.	4	6'	245,412	336,103	171,657	753,172	204,510	336,103	143,055	683,668	2,272	56,825	3,409	62,506	245,412	330,119	171,657	747,188	204,510	330,119	143,055	677,684	2,229	55,720	3,343	61,292
	28	COMM. & INDUST.	4	16'	245,412	367,531	171,657	784,600	204,510	367,531	143,055	715,096	2,272	56,825	3,409	62,506	245,412	360,991	171,657	778,060	204,510	360,991	143,055	708,556	2,229	55,720	3,343	61,292
	28	RESIDENTIAL	4	6'	245,412	325,208	171,657	742,277	204,510	325,208	143,055	672,773	2,142	53,530	3,211	58,883	245,412	319,416	171,657	736,485	204,510	319,416	143,055	666,981	2,100	52,491	3,149	57,740
	28	RESIDENTIAL	4	16'	245,412	356,633	171,657	773,702	204,510	356,633	143,055	704,198	2,142	53,530	3,211	58,883	245,412	350,286	171,657	767,355	204,510	350,286	143,055	697,851	2,100	52,491	3,149	57,740
	29	COMM. & INDUST.	2		242,576	199,913	69,925	512,414	202,146	199,913	58,272	460,331	1,351	33,766	2,026	37,143	242,576	196,369	69,925	508,870	202,146	196,369	58,272	460,197	1,324	33,108	1,986	36,418
	29	COMM. & INDUST.	4	6'	245,412	336,103	171,657	753,172	204,510	336,103	143,055	683,668	2,272	56,825	3,409	62,506	245,412	330,119	171,657	747,188	204,510	330,119	143,055	677,684	2,229	55,720	3,343	61,292
	29	COMM. & INDUST.	4	16'	245,412	367,531	171,657	784,600	204,510	367,531	143,055	715,096	2,272	56,825	3,409	62,506	245,412	360,991	171,657	778,060	204,510	360,991	143,055	708,556	2,229	55,720	3,343	61,292
	29	RESIDENTIAL	2		242,576	188,943	69,925	501,444	202,146	188,943	58,272	449,361	1,219	30,470	1,828	33,517	242,576	185,592	69,925	498,093	202,146	185,592	58,272	446,010	1,195	29,880	1,793	32,868
	29	RESIDENTIAL	4	6'	245,412	325,208	171,657	742,277	204,510	325,208	143,055	672,773	2,142	53,530	3,211	58,883	245,412	319,416	171,657	736,485	204,510	319,416	143,055	666,981	2,100	52,491	3,149	57,740
	29	RESIDENTIAL	4	16'	245,412	356,633	171,657	773,702	204,510	356,633	143,055	704,198	2,142	53,530	3,211	58,883	245,412	350,286	171,657	767,355	204,510	350,286	143,055	697,851	2,100	52,491	3,149	57,740
	30	COMM. & INDUST.	2		242,576	172,714	69,925	485,215	202,146	172,714	58,272	433,132	1,351	33,766	2,026	37,143	242,576	169,638	69,925	482,139	202,146	169,638	58,272	430,056	1,324	33,108	1,986	36,418
	30	RESIDENTIAL	2		242,576	164,312	69,925	476,813	202,146	164,312	58,272	424,730	1,219	30,470	1,828	33,517	242,576	161,385	69,925	473,885	202,146	161,385	58,272	421,803	1,195	29,880	1,793	32,868

URBAN CONSTRUCTION COST SUMMARY NO.2

ROADWAY DESIGN DESCRIPTION					MISSOULA												SMALL URBAN AREAS											
					NEW LOCATION				RECONSTRUCTION				RESURFACING				NEW LOCATION				RECONSTRUCTION				RESURFACING			
FUNCTIONAL CLASSIFICATION	O.S.N	TYPE OF AREA	LANES	MEDIAN	GR. & DR	B. & SURF	OTHER	TOTAL	GR. & DR	B. & SURF.	OTHER	TOTAL	GR. & DR	B. & SURF	OTHER	TOTAL	GR. & DR	B. & SURF	OTHER	TOTAL	GR. & DR	B. & SURF	OTHER	TOTAL	GR. & DR	B. & SURF	OTHER	TOTAL
PRINCIPAL ARTERIALS	24	BUILT UP	2		242,576	201,903	69,925	514,404	202,146	201,903	58,272	462,321	1,362	34,060	2,044	37,466	242,576	202,031	69,925	514,532	202,146	202,031	58,272	462,449	1,364	34,110	2,046	37,520
	24	BUILT UP	4	6'	245,412	339,352	171,657	756,421	204,510	339,352	143,055	686,917	2,293	57,320	3,439	63,052	245,412	339,663	171,657	756,732	204,510	339,663	143,055	687,228	2,296	57,404	3,445	63,145
	24	BUILT UP	4	16'	245,412	371,084	171,657	788,153	204,510	371,084	143,055	718,649	2,293	57,320	3,439	63,052	245,412	371,412	171,657	788,481	204,510	371,412	143,055	718,977	2,296	57,404	3,445	63,145
	24	BUILT UP	6	6'	294,488	361,513	205,988	861,989	245,412	361,513	171,657	778,582	2,559	63,967	3,838	70,364	294,488	361,837	205,988	862,313	245,412	361,837	171,657	778,906	2,562	64,060	3,844	70,466
	24	BUILT UP	6	16'	294,488	393,188	205,988	893,664	245,412	393,188	171,657	810,277	2,559	63,967	3,838	70,364	294,488	393,528	205,988	894,004	245,412	393,528	171,657	810,597	2,562	64,060	3,844	70,466
	25	OUTLYING	2		242,576	201,903	69,925	514,404	202,146	201,903	58,272	462,321	1,362	34,060	2,044	37,466	242,576	202,031	69,925	514,532	202,146	202,031	58,272	462,449	1,364	34,110	2,046	37,520
	25	OUTLYING	4	6'	245,412	339,352	171,657	756,421	204,510	339,352	143,055	686,917	2,293	57,320	3,439	63,052	245,412	339,663	171,657	756,732	204,510	339,663	143,055	687,228	2,296	57,404	3,445	63,145
	25	OUTLYING	4	16'	245,412	371,084	171,657	788,153	204,510	371,084	143,055	718,649	2,293	57,320	3,439	63,052	245,412	371,412	171,657	788,481	204,510	371,412	143,055	718,977	2,296	57,404	3,445	63,145
	25	OUTLYING	6	6'	294,488	361,513	205,988	861,989	245,412	361,513	171,657	778,582	2,559	63,967	3,838	70,364	294,488	361,837	205,988	862,313	245,412	361,837	171,657	778,906	2,562	64,060	3,844	70,466
	25	OUTLYING	6	16'	294,488	393,188	205,988	893,664	245,412	393,188	171,657	810,277	2,559	63,967	3,838	70,364	294,488	393,528	205,988	894,004	245,412	393,528	171,657	810,597	2,562	64,060	3,844	70,466
MINOR ARTERIAL STREET	26	BUILT UP	2		242,576	201,903	69,925	514,404	202,146	201,903	58,272	462,321	1,362	34,060	2,044	37,466	242,576	202,031	69,925	514,532	202,146	202,031	58,272	462,449	1,364	34,110	2,046	37,520
	26	BUILT UP	4	6'	245,412	339,352	171,657	756,421	204,510	339,352	143,055	686,917	2,293	57,320	3,439	63,052	245,412	339,663	171,657	756,732	204,510	339,663	143,055	687,228	2,296	57,404	3,445	63,145
	26	BUILT UP	4	16'	245,412	371,084	171,657	788,153	204,510	371,084	143,055	718,649	2,293	57,320	3,439	63,052	245,412	371,412	171,657	788,481	204,510	371,412	143,055	718,977	2,296	57,404	3,445	63,145
	27	OUTLYING	2		242,576	201,903	69,925	514,404	202,146	201,903	58,272	462,321	1,362	34,060	2,044	37,466	242,576	202,031	69,925	514,532	202,146	202,031	58,272	462,449	1,364	34,110	2,046	37,520
	27	OUTLYING	4	6'	245,412	339,352	171,657	756,421	204,510	339,352	143,055	686,917	2,293	57,320	3,439	63,052	245,412	339,663	171,657	756,732	204,510	339,663	143,055	687,228	2,296	57,404	3,445	63,145
	27	OUTLYING	4	16'	245,412	371,084	171,657	788,153	204,510	371,084	143,055	718,649	2,293	57,320	3,439	63,052	245,412	371,412	171,657	788,481	204,510	371,412	143,055	718,977	2,296	57,404	3,445	63,145
COLLECTOR STREETS	28	COMM. & INDUST	4	6	245,412	339,352	171,657	756,421	204,510	339,352	143,055	686,917	2,293	57,320	3,439	63,052	245,412	339,663	171,657	756,732	204,510	339,663	143,055	687,228	2,296	57,404	3,445	63,145
	28	COMM. & INDUST	4	16'	245,412	371,084	171,657	788,153	204,510	371,084	143,055	718,649	2,293	57,320	3,439	63,052	245,412	371,412	171,657	788,481	204,510	371,412	143,055	718,977	2,296	57,404	3,445	63,145
	28	RESIDENTIAL	4	6'	245,412	328,350	171,657	745,419	204,510	328,350	143,055	675,915	2,160	53,997	3,240	59,397	245,412	328,656	171,657	745,725	204,510	328,656	143,055	676,221	2,163	54,076	3,244	59,484
	28	RESIDENTIAL	4	16'	245,412	360,080	171,657	777,149	204,510	360,088	143,055	707,645	2,160	53,997	3,240	59,397	245,412	360,402	171,657	777,471	204,510	360,402	143,055	707,967	2,163	54,076	3,244	59,484
	29	COMM. & INDUST	2		242,576	201,903	69,925	514,404	202,146	201,903	58,272	462,321	1,362	34,060	2,044	37,466	242,576	202,031	69,925	514,532	202,146	202,031	58,272	462,449	1,364	34,110	2,046	37,520
	29	COMM. & INDUST.	4	6'	245,412	339,352	171,657	756,421	204,510	339,352	143,055	686,917	2,293	57,320	3,439	63,052	245,412	339,663	171,657	756,732	204,510	339,663	143,055	687,228	2,296	57,404	3,445	63,145
	29	COMM. & INDUST.	4	16'	245,412	371,084	171,657	788,153	204,510	371,084	143,055	718,649	2,293	57,320	3,439	63,052	245,412	371,412	171,657	788,481	204,510	371,412	143,055	718,977	2,296	57,404	3,445	63,145
	29	RESIDENTIAL	2		242,576	190,826	69,925	503,327	202,146	190,826	58,272	451,244	1,229	30,736	1,844	33,809	242,576	190,948	69,925	503,449	202,146	190,948	58,272	451,366	1,231	30,781	1,847	33,859
	29	RESIDENTIAL	4	6'	245,412	328,350	171,657	745,419	204,510	328,350	143,055	675,915	2,160	53,997	3,240	59,397	245,412	328,656	171,657	745,725	204,510	328,656	143,055	676,221	2,163	54,076	3,244	59,484
	29	RESIDENTIAL	4	16'	245,412	360,080	171,657	777,149	204,510	360,088	143,055	707,645	2,160	53,997	3,240	59,397	245,412	360,402	171,657	777,471	204,510	360,402	143,055	707,967	2,163	54,076	3,244	59,484
	30	COMM. & INDUST.	2		242,576	174,432	69,925	486,932	202,146	174,432	56,272	434,850	1,362	34,060	2,044	37,466	242,576	174,549	69,925	487,050	202,146	174,549	58,272	434,967	1,364	34,110	2,046	37,520
	30	RESIDENTIAL	2		242,576	165,948	69,925	478,448	202,146	165,948	58,272	426,366	1,229	30,736	1,844	33,809	242,576	166,060	69,925	478,561	202,146	166,060	58,272	426,478	1,231	30,781	1,847	33,859

URBAN CONSTRUCTION COST SUMMARY NO. 3

WIDENING

DESIGN STANDARD NUMBER			LANES	MEDIAN	PARKING*	GREAT FALLS			BILLINGS		
						GRADE & DRAIN	BASE & SURFACE	OTHER COSTS	GRADE & DRAIN	BASE & SURFACE	OTHER COSTS
24 & 25	26 & 27	29	2 LANE	NONE	10'	W($ 3,974)	$121,154 + W($1,710)	W($ 1,494)	W($ 3,974)	$118,687 + W($ 1,681)	W($ 1,494)
24 & 25	26 & 27	28 & 29	4 LANE	6'	10'	W($ 3,974)	$162,909 + W($1,710)	W($ 1,933)	W($ 3,974)	$159,857 + W($ 1,681)	W($ 1,933)
24 & 25	26 & 27	28 & 29	4 LANE	16'	10'	W($ 3,974)	$172,396 + W($1,710)	W($ 1,933)	W($ 3,974)	$169,154 + W($ 1,681)	W($ 1,933)
24 & 25			6 LANE	6'	10'	W($ 3,974)	$170,553 + W($1,710)	W($ 1,752)	W($ 3,974)	$167,347 + W($ 1,681)	W($ 1,752)
24 & 25			6 LANE	16'	10'	W($ 3,974)	$179,982 + W($1,710)	W($ 1,752)	W($ 3,974)	$176,590 + W($ 1,681)	W($ 1,752)
		28 & 29	4 LANE	6'	8'	W($ 3,974)	$159,157 + W($1,710)	W($ 1,933)	W($ 3,974)	$156,176 + W($ 1,681)	W($ 1,933)
		28 & 29	4 LANE	16'	8'	W($ 3,974)	$168,645 + W($1,710)	W($ 1,933)	W($ 3,974)	$165,470 + W($ 1,681)	W($ 1,933)
		29	2 LANE	NONE	8'	W($ 3,974)	$117,325 + W($1,710)	W($ 1,494)	W($ 3,974)	$115,152 + W($ 1,681)	W($ 1,494)
		30	2 LANE	NONE	10'	W($ 3,974)	$110,565 + W($1,289)	W($ 1,494)	W($ 3,974)	$108,520 + W($ 1,268)	W($ 1,494)
		30	2 LANE	NONE	8'	W($ 3,974)	$113,602 + W($1,289)	W($ 1,494)	W($ 3,974)	$111,497 + W($ 1,268)	W($ 1,494)

PRINCIPAL ARTERIALS | MINOR ARTERIALS | COLLECTORS

DESIGN STANDARD NUMBER			LANES	MEDIAN	PARKING*	MISSOULA			SMALL URBAN		
						GRADE & DRAIN	BASE & SURFACE	OTHER COSTS	GRADE & DRAIN	BASE & SURFACE	OTHER COSTS
24 & 25	26 & 27	29	2 LANE	NONE	10'	W($ 3,974)	$122,301 + W($1,727)	W($ 1,494)	W($ 3,974)	$122,426 + W($ 1,727)	W($ 1,494)
24 & 25	26 & 27	28 & 29	4 LANE	6'	10'	W($ 3,974)	$164,446 + W($1,727)	W($ 1,933)	W($ 3,974)	$164,632 + W($ 1,727)	W($ 1,933)
24 & 25	26 & 27	28 & 29	4 LANE	16'	10'	W($ 3,974)	$174,016 + W($1,727)	W($ 1,933)	W($ 3,974)	$174,215 + W($ 1,727)	W($ 1,933)
24 & 25			6 LANE	6'	10'	W($ 3,974)	$172,156 + W($1,727)	W($ 1,752)	W($ 3,974)	$172,353 + W($ 1,727)	W($ 1,752)
24 & 25			6 LANE	16'	10'	W($ 3,974)	$181,666 + W($1,727)	W($ 1,752)	W($ 3,974)	$181,877 + W($ 1,727)	W($ 1,752)
		28 & 29	4 LANE	6'	8'	W($ 3,974)	$160,662 + W($1,727)	W($ 1,933)	W($ 3,974)	$160,842 + W($ 1,727)	W($ 1,933)
		28 & 29	4 LANE	16'	8'	W($ 3,974)	$170,232 + W($1,727)	W($ 1,933)	W($ 3,974)	$170,426 + W($ 1,727)	W($ 1,933)
		29	2 LANE	NONE	8'	W($ 3,974)	$118,459 + W($1,727)	W($ 1,494)	W($ 3,974)	$118,579 + W($ 1,727)	W($ 1,494)
		30	2 LANE	NONE	10'	W($ 3,974)	$111,639 + W($1,303)	W($ 1,494)	W($ 3,974)	$111,748 + W($ 1,303)	W($ 1,494)
		30	2 LANE	NONE	8'	W($ 3,974)	$114,702 + W($1,303)	W($ 1,494)	W($ 3,974)	$114,816 + W($ 1,303)	W($ 1,494)

PRINCIPAL ARTERIALS | MINOR ARTERIALS | COLLECTORS

*NOTE: 10' PARKING INDICATES BUILT UP, OUTLYING, INDUSTRIAL & COMMERCIAL AREAS
8' PARKING INDICATES RESIDENTIAL AREAS ONLY

APPENDIX C

APPENDIX 'C'

MASS ANALYSIS SCHEDULES

Figure No. 23	Schedule MA–8:	Cost Area 1 – Flat
Figure No. 24	Schedule MA–8:	Cost Area 1 – Rolling
Figure No. 25	Schedule MA–8:	Cost Area 1 – Mountainous
Figure No. 26	Schedule MA–8:	Cost Area 2 – Flat
Figure No. 27	Schedule MA–8:	Cost Area 2 – Rolling
Figure No. 28	Schedule MA–8:	Cost Area 2 – Mountainous
Figure No. 29	Schedule MA–9:	Small Urban Areas 5,000 – 9,999
Figure No. 30	Schedule MA–9:	Small Urban Areas 10,000 – 24,999
Figure No. 31	Schedule MA–9:	Small Urban Areas 25,000 – 49,999
Figure No. 32	Schedule MA–12:	Urbanized Area – Billings
Figure No. 33	Schedule MA–12:	Urbanized Area – Great Falls
Figure No. 34	Schedule MA–12:	Urbanized Area – Missoula

Figure No. 23

SCHEDULE MA-8 TOTAL ANNUAL COST WORKSHEET RURAL LOCAL ROADS

COST AREA 1 - FLAT

State Code	Location	Cost Area Code	States	Design Std. Number	Exist. Surf. Type	A: Miles	B: Annual Cost per Mile (From Schedule MA-6) Grade & Drain	C: Annual Cost per Mile (From Schedule MA-6) Base & Surface	D: Annual Cost per Mile (From Schedule MA-6) Structures	E: Annual Costs ($1,000) Grade & Drain A × B	F: Annual Costs ($1,000) Base & Surface A × C	G: Annual Costs ($1,000) Structures A × D	H: Annual Costs ($1,000) Total E + F + G	J: Annual Maintenance Cost Per Mile	K: Annual Maintenance Cost Total ($1,000) A × J	L: Annual Cost of Const. and Maint. ($1,000) H + K	M: Annual Cost of Admin. ($1,000) L × 10 %	N: Total Annual Cost ($1,000) L + M
24	1	1F		31	1	0	524	746	7	0	0	0	0	707	0	0	0	0
24	1	1F		31	2	0	524	908	7	0	0	0	0	707	0	0	0	0
24	1	1F		31	3	26	524	1,210	7	14	31	0	45	707	18	63	6	69
24	1	1F		31	4	295	524	1,614	7	155	476	2	633	707	209	842	84	926
24	1	1F		31	5	90	524	1,860	7	47	167	1	215	374	34	249	25	274
24	1	1F		34	1	0	524	705	54	0	0	0	0	707	0	0	0	0
24	1	1F		34	2	0	524	859	54	0	0	0	0	707	0	0	0	0
24	1	1F		34	3	11	524	1,145	54	6	13	1	20	707	8	28	3	31
24	1	1F		34	4	68	524	1,289	54	36	88	4	128	707	48	176	18	194
24	1	1F		37	1	0	524	705	317	0	0	0	0	707	0	0	0	0
24	1	1F		37	2	0	524	859	317	0	0	0	0	707	0	0	0	0
24	1	1F		37	3	8	524	1,145	317	4	9	3	16	707	6	22	2	24
24	1	1F		42	1	0	603	2,218	0	0	0	0	0	2,910	0	0	0	0
24	1	1F		42	2	0	603	2,701	0	0	0	0	0	2,910	0	0	0	0
24	1	1F		42	3	6	603	3,599	0	4	22	0	26	2,910	17	43	4	47
24	1	1F	Presently Tolerable	•	•	504	Total			266	806	11	1083		340	1,423	142	1565
24	1	1F	2	31	•	1579	1,865	2,243	24	2945	3542	38	6525	707	1116	7,641	764	8405
24	1	1F	2	34	•	2431	1,865	1,684	193	453	409	47	909	707	172	1,081	108	1189
24	1	1F	2 Presently Intolerable	37	•	231	1,865	1,684	1,127	43	39	26	108	707	16	124	12	136
24	1	1F	2	42	•	332	2,143	5,297	0	71	175	0	246	2,910	96	342	34	376
24	1	1F	2	•	•	1878	Total			3512	4165	111	7788		1400	9,188	918	10106
24	1	1F	3	31	•	421	1,865	2,243	24	78	94	1	173	707	30	203	20	223
24	1	1F	3	34	•	01	1,865	1,684	193	0	0	0	0	707	0	0	0	0
24	1	1F	3 New	37	•	01	1,865	1,684	1,127	0	0	0	0	707	0	0	0	0
24	1	1F	3	42	•	02	2,143	5,297	0	0	0	0	0	2,910	0	0	0	0
24	1	1F	3	•	•	42	Total			78	94	1	173		30	203	20	223
24	1	1F	•	•	•	2424	All Roads			3856	5065	123	9044		1770	10,814	1080	11894

Figure No. 24

SCHEDULE MA-8 TOTAL ANNUAL COST WORKSHEET RURAL LOCAL ROADS

COST AREA 1 - ROLLING

State Code	Location	Cost Area Code	Status	Design Std Number	Exist. Surf. Type	A Miles	B Annual Cost per Mile (From Schedule MA-6) Grade & Drain	C Base & Surface	D Structures	E Annual Costs ($1,000) Grade & Drain (A × B)	F Base & Surface (A × C)	G Structures (A × D)	H Total (E + F + G)	J Annual Maintenance Cost Per Mile	K Total ($1,000) (A × J)	L Annual Cost of Const. and Maint. ($1,000) (H + K)	M Annual Cost of Admin. ($1,000) (L × 10%)	N Total Annual Cost ($1,000) (L + M)
24	1	1R	Presently Tolerable	321		0	856	877	7	0	0	0	0	707	0	0	0	0
24	1	1R		322		0	856	1,068	7	0	0	0	0	707	0	0	0	0
24	1	1R		323		45	856	1,422	7	39	64	0	103	707	32	135	14	149
24	1	1R		324		515	856	1,897	7	441	977	4	1422	707	364	1,786	179	1965
24	1	1R		325		157	856	2,186	7	134	343	1	478	374	59	537	54	591
24	1	1R		351		0	856	852	54	0	0	0	0	707	0	0	0	0
24	1	1R		352		0	856	1,037	54	0	0	0	0	707	0	0	0	0
24	1	1R		353		18	856	1,382	54	15	25	1	41	707	13	54	5	59
24	1	1R		354		118	856	1,555	54	101	183	6	290	707	83	373	37	410
24	1	1R		381		0	856	852	317	0	0	0	0	707	0	0	0	0
24	1	1R		382		0	856	1,037	317	0	0	0	0	707	0	0	0	0
24	1	1R		383		14	856	1,382	317	12	19	4	35	707	10	45	5	50
24	1	1R		421		0	603	2,218	0	0	0	0	0	2,910	0	0	0	0
24	1	1R		422		0	603	2,701	0	0	0	0	0	2,910	0	0	0	0
24	1	1R		423		11	603	3,599	0	7	40	0	47	2,910	32	79	8	87
24	1	1R		008		878	Total			749	1651	16	2416		593	3,009	302	3311
24	1	1R	Presently Intolerable	320		2754	3,044	2,636	24	8383	7260	66	15709	707	1947	17,656	1766	19422
24	1	1R		350		425	3,044	2,033	193	1294	864	82	2240	707	300	2,540	254	2794
24	1	1R		380		39	3,044	2,033	1,127	119	79	44	242	707	28	270	27	297
24	1	1R		420		57	2,143	5,297	0	122	302	0	424	2,910	166	590	59	649
24	1	1R		007		3275	Total			9918	8505	192	18615		2441	21,056	2106	23162
24	1	1R	New	320		74	3,044	2,636	24	225	195	2	422	707	52	474	47	521
24	1	1R		350		0	3,044	2,033	193	0	0	0	0	707	0	0	0	0
24	1	1R		380		0	3,044	2,033	1,127	0	0	0	0	707	0	0	0	0
24	1	1R		420		0	2,143	5,297	0	0	0	0	0	2,910	0	0	0	0
24	1	1R		008		74	Total			225	195	2	422		52	474	47	521
24	1	1R		009		4227	All Roads			10892	10351	210	21453		3086	24,539	2455	26994

Figure No. 25

SCHEDULE MA-8 TOTAL ANNUAL COST WORKSHEET RURAL LOCAL ROADS

COST AREA 1 - MOUNTAINOUS

State Code	Location	Cost Area Code	Status	Design Std. Number	Exist. Surf. Type	A Miles	B Annual Cost per Mile (From Schedule MA-6) Grade & Drain	C Base & Surface	D Structures	E Annual Costs ($1,000) Grade & Drain A × B	F Base & Surface A × C	G Structures A × D	H Total E + F + G	J Annual Maintenance Cost Per Mile	K Total ($1,000) A × J	L Annual Cost of Const and Maint. ($1,000) H + K	M Annual Cost of Admin. ($1,000) L × 10%	N Total Annual Cost ($1,000) L + M
24	1	1M	Presently Tolerable	331		0	1,917	879	7	0	0	0	0	707	0	0	0	0
24	1	1M		332		0	1,917	1,070	7	0	0	0	0	707	0	0	0	0
24	1	1M		333		86	1,917	1,426	7	165	123	1	289	707	61	350	35	385
24	1	1M		334		990	1,917	1,901	7	1898	1882	7	3787	707	700	4,487	449	4936
24	1	1M		335		302	1,917	2,191	7	579	662	2	1243	374	113	1,356	136	1492
24	1	1M		361		0	1,917	854	54	0	0	0	0	707	0	0	0	0
24	1	1M		362		0	1,917	1,040	54	0	0	0	0	707	0	0	0	0
24	1	1M		363		35	1,917	1,385	54	67	48	2	117	707	25	142	14	156
24	1	1M		364		227	1,917	1,560	54	435	354	12	801	707	160	961	96	1057
24	1	1M		391		0	1,917	854	317	0	0	0	0	707	0	0	0	0
24	1	1M		392		0	1,917	1,040	317	0	0	0	0	707	0	0	0	0
24	1	1M		393		27	1,917	1,385	317	52	37	9	98	707	19	117	12	129
24	1	1M		421		0	603	2,218	0	0	0	0	0	2,910	0	0	0	0
24	1	1M		422		0	603	2,701	0	0	0	0	0	2,910	0	0	0	0
24	1	1M		423		22	603	3,599	0	13	79	0	92	2,910	64	156	16	172
24	1	1M		000	6	1689	Total			3209	3185	33	6427		1142	7,569	758	8327
24	1	1M	Presently Intolerable	330		5295	6,818	2,642	24	3610	1398	127	5021	707	3744	53,961	5396	59357
24	1	1M		360		818	6,818	2,039	193	557	166	158	740	707	578	7,981	798	8779
24	1	1M		390		75	6,818	2,039	1,127	511	153	85	749	707	53	802	80	882
24	1	1M		420		110	2,143	5,297	0	236	583	0	819	2,910	320	1,139	114	1253
24	1	1M		000	7	6298	Total			4242	1639	370	5918		4695	63,883	6388	70271
24	1	1M	New	330		142	6,818	2,642	24	968	375	3	1346	707	100	1,446	145	1591
24	1	1M		360		0	6,818	2,039	193	0	0	0	0	707	0	0	0	0
24	1	1M		390		0	6,818	2,039	1,127	0	0	0	0	707	0	0	0	0
24	1	1M		420		0	2,143	5,297	0	0	0	0	0	2,910	0	0	0	0
24	1	1M		000	8	142	Total			968	375	3	1346		100	1,446	145	1591
24	1	1M		000	9	8129	All Roads			46602	19953	406	66961		5937	72,898	7291	80189

Figure No. 26

SCHEDULE MA-8 TOTAL ANNUAL COST WORKSHEET RURAL LOCAL ROADS

COST AREA 2 - FLAT

State Code	Location	Cost Area Code	Status	Design Std. Number	Exist. Surf. Type	A Miles	B Annual Cost per Mile (From Schedule MA-6) Grade & Drain	C Base & Surface	D Structures	E Annual Costs ($1,000) Grade & Drain A × B	F Base & Surface A × C	G Structures A × D	H Total E + F + G	J Annual Maintenance Cost Per Mile	K Total ($1,000) A × J	L Annual Cost of Const. and Maint. ($1,000) H + K	M Annual Cost of Admin. ($1,000) L × 10%	N Total Annual Cost ($1,000) L + M
24	1	2F	1	311		0	556	644	16	0	0	0	0	707	0	0	0	0
24	1	2F	1	312		0	556	784	16	0	0	0	0	707	0	0	0	0
24	1	2F	1	313		23	556	1,044	16	13	24	0	37	707	16	53	5	58
24	1	2F	1	314		3898	556	1,393	16	2167	5430	62	7659	707	2756	10,415	1042	11457
24	1	2F	1	315		1502	556	1,605	16	835	2411	24	3270	374	562	3,832	383	4215
24	1	2F	1	341		0	556	625	38	0	0	0	0	707	0	0	0	0
24	1	2F	1	342		0	556	761	38	0	0	0	0	707	0	0	0	0
24	1	2F	1	343		15	556	1,015	38	8	15	1	24	707	11	35	4	39
24	1	2F	1	344		679	556	1,142	38	378	775	26	1179	707	480	1,659	166	1825
24	1	2F	1	371		0	556	625	98	0	0	0	0	707	0	0	0	0
24	1	2F	1	372		0	556	761	98	0	0	0	0	707	0	0	0	0
24	1	2F	1	373		4	556	1,015	98	2	4	0	6	707	3	9	1	10
24	1	2F	1	421		0	603	2,218	0	0	0	0	0	2,910	0	0	0	0
24	1	2F	1	422		0	603	2,701	0	0	0	0	0	2,910	0	0	0	0
24	1	2F	1	423		27	603	3,599	0	16	97	0	113	2,910	79	192	19	211
24	1	2F	1	008		6148	Total			3419	8756	113	12288		3907	16,195	1620	17815
24	1	2F	2	310		5918	1,978	1,936	56	11706	11457	331	23494	707	4184	27,678	2768	30446
24	1	2F	2	340		280	1,978	1,493	134	554	418	38	1010	707	198	1,208	121	1329
24	1	2F	2	370		19	1,978	1,493	347	38	28	7	73	707	13	86	9	95
24	1	2F	2	420		61	2,143	5,297	0	131	323	0	454	2,910	178	632	63	695
24	1	2F	2	007		6278	Total			12429	12226	376	25031		4573	29,604	2961	32565
24	1	2F	3	310		131	1,978	1,936	56	259	254	7	520	707	93	613	61	674
24	1	2F	3	340		0	1,978	1,493	134	0	0	0	0	707	0	0	0	0
24	1	2F	3	370		0	1,978	1,493	347	0	0	0	0	707	0	0	0	0
24	1	2F	3	420		0	2,143	5,297	0	0	0	0	0	2,910	0	0	0	0
24	1	2F	3	008		131	Total			259	254	7	520		93	613	61	674
24	1	2F	0	009		12557	All Roads			16107	21236	496	37839		8573	46,412	4642	51054

Figure No. 27

SCHEDULE MA-8 TOTAL ANNUAL COST WORKSHEET RURAL LOCAL ROADS

COST AREA 2 - ROLLING

State Code	Location	Cost Area Code	Status	Design Std Number	Exist. Surf. Type	A Miles	B Annual Cost per Mile (From Schedule MA-6) Grade & Drain	C Base & Surface	D Structures	E Annual Costs ($1,000) Grade & Drain A × B	F Base & Surface A × C	G Structures A × D	H Total E + F + G	J Annual Maintenance Cost Per Mile	K Total ($1,000) A × J	L Annual Cost of Const. and Maint. ($1,000) H + K	M Annual Cost of Admin. ($1,000) L × 10%	N Total Annual Cost ($1,000) L + M
24	1	2R	Presently Tolerable	321		0	669	778	16	0	0	0	0	707	0	0	0	0
24	1	2R		322		0	669	947	16	0	0	0	0	707	0	0	0	0
24	1	2R		323		27	669	1,262	16	18	34	0	52	707	19	71	7	78
24	1	2R		324		4476	669	1,682	16	2994	7529	72	10595	707	3165	13,760	1376	15136
24	1	2R		325		1725	669	1,939	16	1154	3345	28	4527	374	645	5,172	517	5689
24	1	2R		351		0	669	754	38	0	0	0	0	707	0	0	0	0
24	1	2R		352		0	669	918	38	0	0	0	0	707	0	0	0	0
24	1	2R		353		17	669	1,223	38	11	21	1	33	707	12	45	5	50
24	1	2R		354		781	669	1,377	38	522	1075	30	1627	707	552	2,179	218	2397
24	1	2R		381		0	669	754	98	0	0	0	0	707	0	0	0	0
24	1	2R		382		0	669	918	98	0	0	0	0	707	0	0	0	0
24	1	2R		383		5	669	1,223	98	3	6	0	9	707	4	13	1	14
24	1	2R		421		0	603	2,218	0	0	0	0	0	2,910	0	0	0	0
24	1	2R		422		0	603	2,701	0	0	0	0	0	2,910	0	0	0	0
24	1	2R		423		30	603	3,599	0	18	108	0	126	2,910	87	213	21	234
24	1	2R		006		7061	Total			4720	12118	131	16969		4484	21,453	2145	23598
24	1	2R	Presently Intolerable	320		6793	2,379	2,338	56	16161	15882	380	32423	707	4803	37,226	3723	40949
24	1	2R		350		321	2,379	1,800	134	764	578	43	1385	707	227	1,612	161	17773
24	1	2R		380		22	2,379	1,800	347	52	40	8	100	707	16	116	12	128
24	1	2R		420		70	2,143	5,297	0	150	371	0	521	2,910	204	725	72	797
24	1	2R		007		7206	Total			17127	16871	431	34429		5250	39,679	3968	43647
24	1	2R	New	320		150	2,379	2,338	56	357	351	8	716	707	106	822	82	904
24	1	2R		350		0	2,379	1,800	134	0	0	0	0	707	0	0	0	0
24	1	2R		380		0	2,379	1,800	347	0	0	0	0	707	0	0	0	0
24	1	2R		420		0	2,143	5,297	0	0	0	0	0	2,910	0	0	0	0
24	1	2R		008		150	Total			357	351	8	716		106	822	82	904
24	1	2R		009		14417	All Roads			22204	29340	570	52114		9840	61,954	6125	68149

Figure No. 28

SCHEDULE MA-8 TOTAL ANNUAL COST WORKSHEET RURAL LOCAL ROADS

COST AREA 2 - MOUNTAINOUS

State Code	Location	Cost Area Code	Status	Design Std. Number	Exist. Surf. Type	A Miles	B Annual Cost per Mile (From Schedule MA-6) Grade & Drain	C Base & Surface	D Structures	E Annual Costs ($1,000) Grade & Drain (A × B)	F Base & Surface (A × C)	G Structures (A × D)	H Total (E + F + G)	J Annual Maintenance Cost Per Mile	K Total ($1,000) (A × J)	L Annual Cost of Const. and Maint. ($1,000) (H + K)	M Annual Cost of Admin. ($1,000) (L × 10%)	N Total Annual Cost ($1,000) (L + M)
24	1	2M	1	331		0	929	778	16	0	0	0	0	707	0	0	0	0
24	1	2M	1	332		0	929	947	16	0	0	0	0	707	0	0	0	0
24	1	2M	1	333		4	929	1,262	16	4	5	0	9	707	3	12	1	13
24	1	2M	1	334		6.5	0	929	1,683	16	6	04	10	94	10	17	08	707
24	1	2M	1	335		2.5	0	929	1,939	16	2	32	4	85	4	7	21	374
24	1	2M	1	361		0	929	758	38	0	0	0	0	707	0	0	0	0
24	1	2M	1	362		0	929	923	38	0	0	0	0	707	0	0	0	0
24	1	2M	1	363		2	929	1,230	38	2	2	0	4	707	1	5	1	6
24	1	2M	1	364		1.3	929	1,385	38	10	5	1.5	7	4	26	6	707	80
24	1	2M	1	391		0	929	758	98	0	0	0	0	707	0	0	0	0
24	1	2M	1	392		0	929	923	98	0	0	0	0	707	0	0	0	0
24	1	2M	1	393		1	929	1,230	98	1	1	0	2	707	1	3	0	3
24	1	2M	1	421		0	603	2,218	0	0	0	0	0	2,910	0	0	0	0
24	1	2M	1	422		0	603	2,701	0	0	0	0	0	2,910	0	0	0	0
24	1	2M	1	423		5	603	3,599	0	3	1.8	0	21	2,910	15	36	4	40
24	1	2M	1	•••		10.25	Total			951	1762	18	2731		654	3,385	339	3724
24	1	2M	2	33•		9.86	3,304	2,339	56	325.8	2306	5.5	5619	707	697	6,316	632	6948
24	1	2M	2	36•		4.7	3,304	1,810	134	15.5	8.5	6	245	707	33	279	28	307
24	1	2M	2	39•		3.3	3,304	1,810	347	10	5	1	16	707	2	18	2	20
24	1	2M	2	42•		10	2,143	5,297	0	21	53	0	74	2,910	29	103	10	113
24	1	2M	2	••7		1046	Total			3444	2449	62	5955		761	6,716	672	7388
24	1	2M	3	33•		2.2	3,304	2,339	56	7.3	5.1	1	125	707	16	141	14	155
24	1	2M	3	36•		0	3,304	1,810	134	0	0	0	0	707	0	0	0	0
24	1	2M	3	39•		0	3,304	1,810	347	0	0	0	0	707	0	0	0	0
24	1	2M	3	42•		0	2,143	5,297	0	0	0	0	0	2,910	0	0	0	0
24	1	2M	3	•••		2.2	Total			7.3	5.1	1	125		16	141	14	155
24	1	2M	•	•••		2093	All Roads			4468	4262	81	8811		1431	10,242	1025	11267

Figure No. 29

SCHEDULE MA-9 TOTAL ANNUAL COST WORKSHEET URBAN LOCAL STREETS

Small Urban Areas 5,000-9,999

State Code	Location	Urb. Area Code	Cost Area Code	Status	Design Std. Number	Exist. Surf. Type	A Miles	B Annual Cost per Mile (From Schedule MA-7) Grade & Drain	B Annual Cost per Mile (From Schedule MA-7) Base & Surface	E Annual Costs ($1,000) Grade & Drain (A × B)	F Annual Costs ($1,000) Base & Surface (A × C)	H Annual Costs ($1,000) Total (E + F)	J Annual Maintenance Cost Per Mile	K Annual Maintenance Cost Total ($1,000) (A × J)	L Annual Cost of Const. and Maint. ($1,000) (H + K)	M Annual Cost of Admin. ($1,000) (L × 3.2%)	N Total Annual Cost ($1,000) (L + M)
24	2	997	001	Presently Tolerable	401	1	0	1,341	7,910	0	0	0	4,537	0	0	0	0
24	2	997	001	Presently Tolerable	402	2	0	1,341	9,363	0	0	0	4,537	0	0	0	0
24	2	997	001	Presently Tolerable	403	3	0	1,341	11,812	0	0	0	4,537	0	0	0	0
24	2	997	001	Presently Tolerable	411	1	0	875	5,747	0	0	0	2,910	0	0	0	0
24	2	997	001	Presently Tolerable	412	2	13	875	6,803	11	88	99	2,910	38	137	4	141
24	2	997	001	Presently Tolerable	413	3	0	875	8,582	0	0	0	2,910	0	0	0	0
24	2	997	001	Presently Tolerable	421	1	0	603	2,218	0	0	0	2,910	0	0	0	0
24	2	997	001	Presently Tolerable	422	2	0	603	2,701	0	0	0	2,910	0	0	0	0
24	2	997	001	Presently Tolerable	423	3	14	603	3,599	8	50	58	2,910	41	99	3	102
24	2	997	001	Presently Tolerable	431	1	10	641	4,240	6	42	48	2,910	29	77	2	79
24	2	997	001	Presently Tolerable	432	2	14	641	5,163	9	72	81	2,910	41	122	4	126
24	2	997	001	Presently Tolerable	433	3	22	641	6,533	14	144	158	2,910	64	222	7	229
24	2	997	001	Presently Tolerable	441	1	7	758	4,603	5	32	37	2,910	20	57	2	59
24	2	997	001	Presently Tolerable	442	2	23	758	5,605	17	129	146	2,910	67	213	7	220
24	2	997	001	Presently Tolerable	443	3	45	758	7,093	34	319	353	2,910	131	484	15	499
24	2	997	001	Presently Tolerable	006		148	Total		104	876	980		431	1,411	44	1455
24	2	997	002	Presently Intolerable	400		0	4,769	16,224	0	0	0	4,537	0	0	0	0
24	2	997	002	Presently Intolerable	410		27	3,110	11,788	84	318	402	2,910	79	481	15	496
24	2	997	002	Presently Intolerable	420		9	2,143	5,297	19	48	67	2,910	26	93	3	96
24	2	997	002	Presently Intolerable	430		9	2,281	9,215	21	83	104	2,910	26	130	4	134
24	2	997	002	Presently Intolerable	440		24	2,696	10,005	65	240	305	2,910	70	375	12	387
24	2	997	002	Presently Intolerable	007		69	Total		189	689	878		201	1,079	34	1113
24	2	997	003	New	400		0	500	3,794	0	0	0	4,537	0	0	0	0
24	2	997	003	New	410		7	326	2,756	2	19	21	2,910	20	41	1	42
24	2	997	003	New	420		4	225	2,090	1	8	9	2,910	12	21	1	22
24	2	997	003	New	430		9	239	2,769	2	25	27	2,910	26	53	2	55
24	2	997	003	New	440		16	282	3,006	5	48	53	2,910	47	100	3	103
24	2	997	003	New	008		36	Total		10	100	110		105	215	7	222
24	2	997	000		009		253	All Streets		303	1665	1968		737	2,705	85	2790

Figure No. 30

SCHEDULE MA-10 TOTAL ANNUAL COST WORKSHEET URBAN LOCAL STREETS

Small Urban Areas 10,000-24,999

State Code	Location	Urb. Area Code	Cost Area Code	Status	Design Std. Number	Exist. Surf. Type	A Miles	B Annual Cost per Mile (From Schedule MA-7) Grade & Drain	C Annual Cost per Mile (From Schedule MA-7) Base & Surface	E Annual Costs ($1,000) Grade & Drain A × B	F Annual Costs ($1,000) Base & Surface A × C	H Annual Costs ($1,000) Total E + F	J Annual Maintenance Cost Per Mile	K Annual Maintenance Cost Total ($1,000) A × J	L Annual Cost of Const. and Maint. ($1,000) H + K	M Annual Cost of Admin. ($1,000) L × 22%	N Total Annual Cost ($1,000) L + M
24	3	8998	00	1	Presently Tolerable	401	0	1,341	7,910	0	0	0	4,537	0	0	0	0
24	3	8998	00	1		402	0	1,341	9,363	0	0	0	4,537	0	0	0	0
24	3	9998	00	1		403	0	1,341	11,812	0	0	0	4,537	0	0	0	0
24	3	9998	00	1		411	8	875	5,747	7	46	53	2,910	23	76	5	81
24	3	8998	00	1		412	0	875	6,803	0	0	0	2,910	0	0	0	0
24	3	9998	00	1		413	0	875	8,582	0	0	0	2,910	0	0	0	0
24	3	9998	00	1		421	0	603	2,218	0	0	0	2,910	0	0	0	0
24	3	9998	00	1		422	0	603	2,701	0	0	0	2,910	0	0	0	0
24	3	9998	00	1		423	0	603	3,599	0	0	0	2,910	0	0	0	0
24	3	9998	00	1		431	7	641	4,240	4	30	34	2,910	20	54	4	58
24	3	8998	00	1		432	0	641	5,163	0	0	0	2,910	0	0	0	0
24	3	9998	00	1		433	0	641	6,533	0	0	0	2,910	0	0	0	0
24	3	9998	00	1		441	25	758	4,603	19	115	134	2,910	73	207	15	222
24	3	9998	00	1		442	0	758	5,605	0	0	0	2,910	0	0	0	0
24	3	9998	00	1		443	0	758	7,093	0	0	0	2,910	0	0	0	0
24	3	9998	00	1		006	40	Total		30	191	221		116	337	24	361
24	3	9998	00	2	Presently Intolerable	400	0	4,769	16,224	0	0	0	4,537	0	0	0	0
24	3	9998	00	2		410	13	3,110	11,788	40	153	193	2,910	38	231	17	248
24	3	9998	00	2		420	19	2,143	5,297	41	101	142	2,910	55	197	14	211
24	3	9998	00	2		430	30	2,281	9,215	68	276	344	2,910	87	431	31	462
24	3	9998	00	2		440	12	2,696	10,005	32	120	152	2,910	35	187	13	200
24	3	8998	00	2		007	74	Total		181	650	831		215	1,046	75	1121
24	3	8998	00	3	New	400	0	500	3,794	0	0	0	4,537	0	0	0	0
24	3	9998	00	3		410	3	326	2,756	1	8	9	2,910	9	18	1	19
24	3	9998	00	3		420	2	225	2,090	0	4	4	2,910	6	10	1	11
24	3	9998	00	3		430	4	239	2,769	1	11	12	2,910	12	24	2	26
24	3	9998	00	3		440	4	282	3,006	1	12	13	2,910	12	25	2	27
24	3	9998	00	3		009	13	Total		3	35	38		39	77	6	83
24	3	9998	00	0		00	127	All Streets		214	876	1090		370	1,460	105	1565

Figure No. 31

SCHEDULE MA-11 TOTAL ANNUAL COST WORKSHEET URBAN LOCAL STREETS

Small Urban Areas 25,000-49,999

State Code	Location	Urb. Area Code	Cost Area Code	Status	Design Std. Number	Exist. Surf. Type	A Miles	B Annual Cost per Mile (From Schedule MA-7) Grade & Drain	C Annual Cost per Mile (From Schedule MA-7) Base & Surface	E Annual Costs ($1,000) Grade & Drain A × B	F Annual Costs ($1,000) Base & Surface A × C	H Annual Costs ($1,000) Total E + F	J Annual Maintenance Cost Per Mile	K Annual Maintenance Cost Total ($1,000) A × J	L Annual Cost of Const. and Maint. ($1,000) H + K	M Annual Cost of Admin. ($1,000) L × 7.7%	N Total Annual Cost ($1,000) L + M
24	4	9999	00	1	40	1	0	1,341	7,910	0	0	0	4,537	0	0	0	0
24	4	9999	00	1	40	2	0	1,341	9,363	0	0	0	4,537	0	0	0	0
24	4	9999	00	1	40	3	0	1,341	11,812	0	0	0	4,537	0	0	0	0
24	4	9999	00	1	41	1	3	875	5,747	3	17	20	2,910	9	29	2	31
24	4	9999	00	1	41	2	2	875	6,803	2	14	16	2,910	6	22	2	24
24	4	9999	00	1	41	3	2	875	8,582	2	17	19	2,910	6	25	2	27
24	4	9999	00	1	42	1	0	603	2,218	0	0	0	2,910	0	0	0	0
24	4	9999	00	1	42	2	3	603	2,701	2	8	10	2,910	9	19	1	20
24	4	9999	00	1	42	3	0	603	3,599	0	0	0	2,910	0	0	0	0
24	4	9999	00	1	43	1	0	641	4,240	0	0	0	2,910	0	0	0	0
24	4	9999	00	1	43	2	11	641	5,163	7	57	64	2,910	32	96	7	103
24	4	9999	00	1	43	3	0	641	6,533	0	0	0	2,910	0	0	0	0
24	4	9999	00	1	44	1	12	758	4,603	9	55	64	2,910	35	99	8	107
24	4	9999	00	1	44	2	223	758	5,605	169	1250	1419	2,910	649	2,068	159	2227
24	4	9999	00	1	44	3	0	758	7,093	0	0	0	2,910	0	0	0	0
24	4	9999	00	1	00	8	256	Total		194	1418	1612		746	2,358	181	2539
24	4	9999	00	2	40	0	0	4,769	16,224	0	0	0	4,537	0	0	0	0
24	4	9999	00	2	41	0	41	3,110	11,788	128	483	611	2,910	119	730	56	786
24	4	9999	00	2	42	0	6	2,143	5,297	13	32	45	2,910	17	62	5	67
24	4	9999	00	2	43	0	31	2,281	9,215	71	286	357	2,910	90	447	34	481
24	4	9999	00	2	44	0	15	2,696	10,005	40	150	190	2,910	44	234	18	252
24	4	9999	00	2	00	7	93	Total		252	951	1203		270	1,473	113	1586
24	4	9999	00	3	40	0	0	500	3,794	0	0	0	4,537	0	0	0	0
24	4	9999	00	3	41	0	35	326	2,756	11	96	107	2,910	102	209	16	225
24	4	9999	00	3	42	0	6	225	2,090	1	13	14	2,910	17	31	2	33
24	4	9999	00	3	43	0	32	239	2,769	8	89	97	2,910	93	190	15	205
24	4	9999	00	3	44	0	184	282	3,006	52	553	605	2,910	535	1,140	88	1228
24	4	9999	00	3	00	8	257	Total		72	751	823		747	1,570	121	1691
24	4	9999	00	0	00	9	606	All Streets		518	3120	3638		1763	5,401	415	5816

Figure No. 32

SCHEDULE MA-12 TOTAL ANNUAL COST WORKSHEET URBAN LOCAL STREETS

Urbanized Area Name BILLINGS

State Code	Location	Urb. Area Code	Cost Area Code	Status	Design Std. Number	Exist. Surf. Type	A Miles	B Annual Cost per Mile (From Schedule MA-7) Grade & Drain	C Annual Cost per Mile (From Schedule MA-7) Base & Surface	E Annual Costs ($1,000) Grade & Drain A × B	F Annual Costs ($1,000) Base & Surface A × C	H Annual Costs ($1,000) Total E + F	J Annual Maintenance Cost Per Mile	K Annual Maintenance Cost Total ($1,000) A × J	L Annual Cost of Const. and Maint. ($1,000) H + K	M Annual Cost of Admin. ($1,000) L × 9.5%	N Total Annual Cost ($1,000) L + M
24	5	121	00	1	40	1	0	1,341	7,689	0	0	0	4,537	0	0	0	0
24	5	121	00	1	40	2	0	1,341	9,101	0	0	0	4,537	0	0	0	0
24	5	121	00	1	40	3	0	1,341	11,482	0	0	0	4,537	0	0	0	0
24	5	121	00	1	41	1	16	875	5,586	14	89	103	2,910	47	150	14	164
24	5	121	00	1	41	2	0	875	6,612	0	0	0	2,910	0	0	0	0
24	5	121	00	1	41	3	0	875	8,342	0	0	0	2,910	0	0	0	0
24	5	121	00	1	42	1	18	603	2,147	11	39	50	2,910	52	102	10	112
24	5	121	00	1	42	2	1	603	2,614	1	3	4	2,910	3	7	1	8
24	5	121	00	1	42	3	0	603	3,483	0	0	0	2,910	0	0	0	0
24	5	121	00	1	43	1	15	641	4,120	10	62	72	2,910	44	116	11	127
24	5	121	00	1	43	2	1	641	5,017	1	5	6	2,910	3	9	1	10
24	5	121	00	1	43	3	0	641	6,349	0	0	0	2,910	0	0	0	0
24	5	121	00	1	44	1	8	758	4,474	6	36	42	2,910	23	65	6	71
24	5	121	00	1	44	2	104	758	5,447	79	566	645	2,910	303	948	90	1038
24	5	121	00	1	44	3	0	758	6,893	0	0	0	2,910	0	0	0	0
24	5	121	00	1	00	6	163	Total		122	800	922		475	1,397	133	1530
24	5	121	00	2	40	0	0	4,769	15,770	0	0	0	4,537	0	0	0	0
24	5	121	00	2	41	0	10	3,110	11,458	31	115	146	2,910	30	176	17	193
24	5	121	00	2	42	0	31	2,143	5,126	66	159	225	2,910	90	315	30	345
24	5	121	00	2	43	0	15	2,281	8,955	34	134	168	2,910	44	212	20	232
24	5	121	00	2	44	0	10	2,696	9,723	27	97	124	2,910	30	154	15	169
24	5	121	00	2	00	7	66	Total		158	505	663		194	857	82	939
24	5	121	00	3	40	0	0	500	3,688	0	0	0	4,537	0	0	0	0
24	5	121	00	3	41	0	24	326	2,679	8	64	72	2,910	70	142	13	155
24	5	121	00	3	42	0	46	225	2,022	10	93	103	2,910	134	237	23	260
24	5	121	00	3	43	0	30	239	2,691	7	81	88	2,910	87	175	17	192
24	5	121	00	3	44	0	113	282	2,922	32	330	362	2,910	329	691	66	757
24	5	121	00	3	00	8	213	Total		57	568	625		620	1,245	119	1364
24	5	121	00	0	00	9	442	All Streets		337	1873	2210		1289	3,499	334	3833

Figure No. 33

SCHEDULE MA-12 TOTAL ANNUAL COST WORKSHEET URBAN LOCAL STREETS

Urbanized Area Name GREAT FALLS

State Code	Location	Urb. Area Code	Cost Area Code	Status	Design Std. Number	Exist. Surf. Type	A Miles	B Annual Cost per Mile (From Schedule MA-7) Grade & Drain	C Base & Surface	E Annual Costs ($1,000) Grade & Drain (A × B)	F Base & Surface (A × C)	H Total (E + F)	J Annual Maintenance Cost Per Mile	K Total ($1,000) (A × J)	L Annual Cost of Const. and Maint. ($1,000) (H + K)	M Annual Cost of Admin. ($1,000) (L × 9.5%)	N Total Annual Cost ($1,000) (L + M)
24	5	122	00	1	401		0	1,341	7,828	0	0	0	4,537	0	0	0	0
24	5	122	00	1	402		0	1,341	9,265	0	0	0	4,537	0	0	0	0
24	5	122	00	1	403		0	1,341	11,688	0	0	0	4,537	0	0	0	0
24	5	122	00	1	411		0	875	5,687	0	0	0	2,910	0	0	0	0
24	5	122	00	1	412		1	875	6,732	1	7	8	2,910	3	11	1	12
24	5	122	00	1	413		0	875	8,492	0	0	0	2,910	0	0	0	0
24	5	122	00	1	421		2	603	2,179	1	4	5	2,910	6	11	1	12
24	5	122	00	1	422		1	603	2,653	1	3	4	2,910	3	7	1	8
24	5	122	00	1	423		0	603	3,535	0	0	0	2,910	0	0	0	0
24	5	122	00	1	431		3	641	4,195	2	13	15	2,910	9	24	2	26
24	5	122	00	1	432		28	641	5,108	18	143	161	2,910	81	242	23	265
24	5	122	00	1	433		0	641	6,464	0	0	0	2,910	0	0	0	0
24	5	122	00	1	441		10	758	4,555	8	46	54	2,910	29	83	8	91
24	5	122	00	1	442		86	758	5,546	65	477	542	2,910	250	792	75	867
24	5	122	00	1	443		0	758	7,018	0	0	0	2,910	0	0	0	0
24	5	122	00	1	006		131	Total		96	693	789		381	1,170	111	1281
24	5	122	00	2	400		0	4,769	16,055	0	0	0	4,537	0	0	0	0
24	5	122	00	2	410		10	3,110	11,665	31	117	148	2,910	29	177	17	194
24	5	122	00	2	420		17	2,143	5,202	36	88	124	2,910	49	173	16	189
24	5	122	00	2	430		38	2,281	9,118	87	346	433	2,910	111	544	52	596
24	5	122	00	2	440		9	2,696	9,900	24	89	113	2,910	26	139	13	152
24	5	122	00	2	007		74	Total		178	640	818		215	1,033	98	1131
24	5	122	00	3	400		0	500	3,754	0	0	0	4,537	0	0	0	0
24	5	122	00	3	410		5	326	2,728	2	14	16	2,910	15	31	3	34
24	5	122	00	3	420		10	225	2,053	2	20	22	2,910	29	51	5	56
24	5	122	00	3	430		33	239	2,740	8	90	98	2,910	96	194	18	212
24	5	122	00	3	440		50	282	2,975	14	149	163	2,910	146	309	29	338
24	5	122	00	3	008		98	Total		26	273	299		286	585	55	640
24	5	122	00	0	009		303	All Streets		300	1606	1906		882	2,788	264	3052

Figure No. 34

SCHEDULE MA-12 TOTAL ANNUAL COST WORKSHEET URBAN LOCAL STREETS

Urbanized Area Name MISSOULA

State Code	Location	Urb. Area Code	Cost Area Code	Status	Design Std. Number	Exist. Surf. Type	A Miles	B Annual Cost per Mile (From Schedule MA-7) Grade & Drain	C Annual Cost per Mile (From Schedule MA-7) Base & Surface	E Annual Costs ($1,000) Grade & Drain A × B	F Annual Costs ($1,000) Base & Surface A × C	H Annual Costs ($1,000) Total E + F	J Annual Maintenance Cost Per Mile	K Annual Maintenance Cost Total ($1,000) A × J	L Annual Cost of Const. and Maint. ($1,000) H + K	M Annual Cost of Admin. ($1,000) L × 9.5%	N Total Annual Cost ($1,000) L + M
24	S	41000	1	Presently Tolerable	40	1	0	1,341	7,905	0	0	0	4,537	0	0	0	0
24	S	41000	1	Presently Tolerable	40	2	0	1,341	9,357	0	0	0	4,537	0	0	0	0
24	S	41000	1	Presently Tolerable	40	3	0	1,341	11,804	0	0	0	4,537	0	0	0	0
24	S	41000	1	Presently Tolerable	41	1	1	875	5,744	1	6	7	2,910	3	10	1	11
24	S	41000	1	Presently Tolerable	41	2	3	875	6,799	3	20	23	2,910	9	32	3	35
24	S	41000	1	Presently Tolerable	41	3	1	875	8,577	1	9	10	2,910	3	13	1	14
24	S	41000	1	Presently Tolerable	42	1	2	603	2,205	1	4	5	2,910	6	11	1	12
24	S	41000	1	Presently Tolerable	42	2	8	603	2,685	5	21	26	2,910	23	49	5	54
24	S	41000	1	Presently Tolerable	42	3	0	603	3,577	0	0	0	2,910	0	0	0	0
24	S	41000	1	Presently Tolerable	43	1	7	641	4,237	4	30	34	2,910	20	54	5	59
24	S	41000	1	Presently Tolerable	43	2	48	641	5,159	31	248	279	2,910	140	419	40	459
24	S	41000	1	Presently Tolerable	43	3	1	641	6,528	1	7	8	2,910	3	11	1	12
24	S	41000	1	Presently Tolerable	44	1	3	758	4,600	2	14	16	2,910	9	25	2	27
24	S	41000	1	Presently Tolerable	44	2	9	758	5,601	7	50	57	2,910	26	83	8	91
24	S	41000	1	Presently Tolerable	44	3	0	758	7,088	0	0	0	2,910	0	0	0	0
24	S	41000	1	Presently Tolerable	00	6	83	Total		56	409	465		242	707	67	774
24	S	41000	2	Presently Intolerable	40	0	0	4,769	16,214	0	0	0	4,537	0	0	0	0
24	S	41000	2	Presently Intolerable	41	0	14	3,110	11,781	44	165	209	2,910	41	250	24	274
24	S	41000	2	Presently Intolerable	42	0	18	2,143	5,265	39	95	134	2,910	52	186	18	204
24	S	41000	2	Presently Intolerable	43	0	48	2,281	9,209	109	442	551	2,910	140	691	66	757
24	S	41000	2	Presently Intolerable	44	0	10	2,696	9,998	27	100	127	2,910	29	156	15	171
24	S	41000	2	Presently Intolerable	00	7	90	Total		219	802	1021		262	1,283	123	1406
24	S	41000	3	New	40	0	0	500	3,791	0	0	0	4,537	0	0	0	0
24	S	41000	3	New	41	0	20	326	2,755	7	55	62	2,910	58	120	11	131
24	S	41000	3	New	42	0	29	225	2,077	7	60	67	2,910	84	151	14	165
24	S	41000	3	New	43	0	108	239	2,767	26	299	325	2,910	314	639	61	700
24	S	41000	3	New	44	0	23	282	3,004	6	69	75	2,910	67	142	13	155
24	S	41000	3	New	00	8	180	Total		46	483	529		523	1,052	99	1151
24	S	41000	0		00	9	353	All Streets		321	1694	2015		1027	3,042	289	3331